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PROGRAM MANAGER

Journal of the Defense Systems Management College

DEFENSE HELICOPTER INDUSTRY
SOURCE SELECTION
CONCURRENT ENGINEERING
MANAGING THE 2005 WORK FORCE

PROGRAM MANAGER

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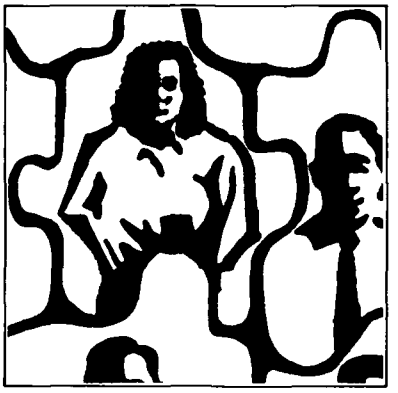

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Whenever in this publication "man," "men," or their related pronouns appear, either as words or parts of words (other than with obvious reference to named male individuals), they have been used for literary purposes and are meant in their generic sense.

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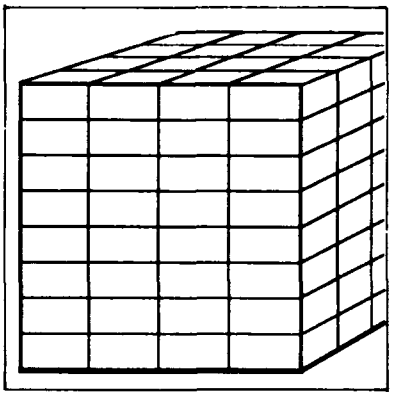

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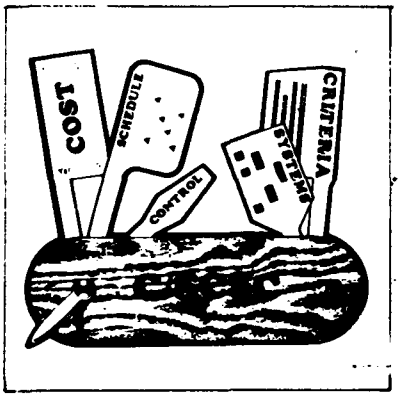

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Cover: During the National Victory Celebration June 8, examples of most helicopters used by each U.S. Armed Service in support of Operation Desert Storm were displayed on the Mall in Washington, D.C. The cover picture shows a U.S. Army CH-47D Chinook, a heavy lift, cargo/troop carrying helicopter, in front of domes of the Capitol and the Library of Congress. (DOD photo by R.D. Ward, The Pentagon.)

Program Manager is intended to be a vehicle for the transmission of information on policies, trends, events, and current thinking affecting program management and defense systems acquisition.

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DEFENSE HELICOPTER INDUSTRY CONTRACTOR TEAMING

A Strategy For Survival

Lieutenant Colonel Michael J. Vanairsdale, USA

The purpose of this paper is to analyze the current condition of the U.S. defense helicopter industry. I will describe the state of the industry and provide its mid- and near-term forecast. I will identify factors contributing to industry's condition and discuss alternative policy options to address its challenges. I will defend my recommended course of action.

The U.S. military helicopter industry consists of four major manufacturers: Bell Helicopter-Textron, Boeing Helicopters, McDonnell Douglas Helicopter Company (MDHC), and Sikorsky Aircraft. These producers account for over 98 percent of current and planned military helicopter production.[1]

With four firms accounting for the vast majority of deliveries, the military helicopter industry qualifies as an oligopoly as described by Baumol and Blinder, "a market dominated by a few sellers, at least several of which are large enough relative to the total market to influence the market price."[2] Barriers to enter the industry are similar to those of other high technology, high

LTC Vanairsdale is the Deputy Director of Investment, Office of the Assistant Secretary of the Army (Financial Management).

unit cost, low production quantity industries. Barriers to entry include enormous capital investment, scarce human technological expertise, systems too complex for a single firm to innovate all subsystems, and significant time lag in return on investment.

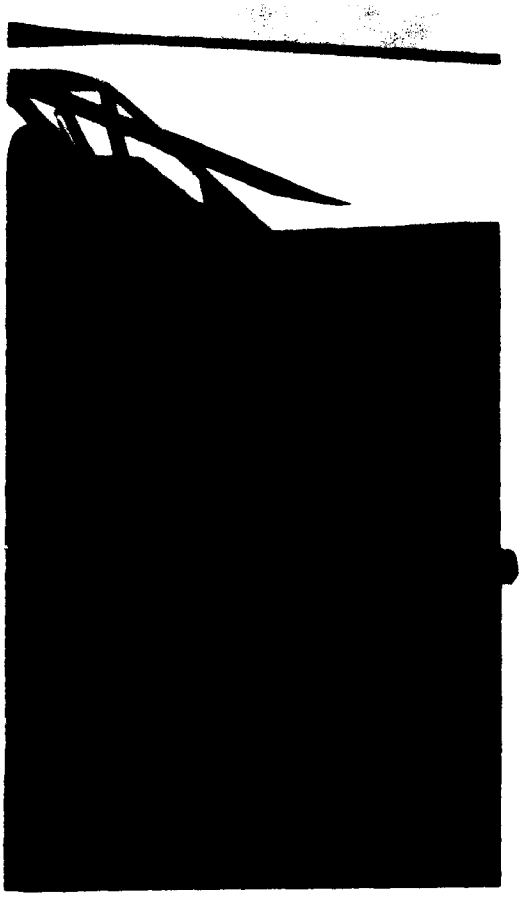
Because of the collapse of the Warsaw Pact, the apparent reduction of the Soviet threat through CFE negotiations, and the pressure to reduce the growing national debt, military force structure and resources available will most certainly be significantly reduced over the next 5 years. The Base Force Plan, described by General Colin Powell in recent congressional testimony, introduces the force structure of the future, some 75 percent of its present size. The Department of Defense investment spending, procurement and RDTE, will likely be reduced correspondingly. The international defense structure is also affected by the Warsaw Pact/Soviet threat reduction. The NATO countries all face resource constraints this year in light of the apparently decreased threat. Demand for military helicopters will significantly decrease worldwide.

Budget Pressure

Budget pressures on force structure are not the only source of troubles for military programs: The Government Accounting Office (GAO) is doing its best to reduce the Army's already meager $1.6 billion FY91 aircraft procurement line. In a report released in December 1990, GAO identified potential reductions of $375 million in FY89-91 Aircraft Procurement and RDTE lines.[3]

What does this mean to the U.S. military helicopter industry? Predictions for the military rotorcraft industry for the next 10 years are even less optimistic than they were a year ago, declining from 7,200 forecast deliveries last year at this time to a forecast of 4,900 this year, for the same 10-year period.[4] In the near-term, total DOD spending for military helicopters in FY91 is $4.6 billion, a 25 percent decrease from the $6.1 billion budgeted in FY90 (see Figure 1).[5] The production lines for AH-64, UH-60, and OH-58D will also come to an end if the President's FY92 budget is upheld.

While this is a significant reduction, all is not gloom and doom. The most promising future military helicopter programs are the resilient Marine Corps Navy V-22 Program, and the Army Light Helicopter (LH) Program, both of which are facing a brighter future than anytime in the past. Currently, Bell and Boeing are teamed to coproduce the V-22, and Boeing and Sikorsky are teamed for full-scale development (FSD) of the LH, now called the AH-66 Commanche, with follow-on production if current plans hold. The V-22 has many friends in the Congress, and this year in the Presidents's budget, the LH received an additional $300 million over last year's program. Helicopter tactical success in the Gulf may also change minds regarding program cuts. The long-term military export picture appears relatively strong as well, due primarily to the Iraq crisis. In addition, the Far East is forecast to be a significant future market. Nevertheless, the challenge to industry is significant.



The RAH-66 Commanche is the Army's hi-tech helicopter for the future. (Photos courtesy of Boeing Helicopter)

NTH Program

One future military program that is unique to conventional military procurement is the Army New Training Helicopter (NTH) Program. The NTH is designed to procure 200+ commercial helicopters as trainers for the U.S. Army Flight School at Ft. Rucker, Ala. The contenders are Schweizer 330, The Enstrom 480, the Aerospatiale 350B, and a Bell 206 derivative, modified by Global Helicopters.[7] The peculiarities of this contract—guaranteeing flight-training hours while depending on a different contractor's maintenance, coupled with uncertain long-term DOD commitment—have discouraged the "Big Four" from becoming involved in the NTH.

With defense budgets falling, manufacturers who do not participate in the few remaining programs will fail to retain market share and presence, will fail to replace lost revenues, and will be unable to maintain technological excellence for future success. If the V-22 is scrapped, Bell could very well be out of the military market. However, Bell's position as a civil helicopter manufacturer is not in danger. The losers in the LH competition said goodbye to 15 years of investment and research and development (R&D). The winners will lead the industry for the foreseeable future. Should both V-22 and LH fail through more severe budget cuts, given the current environment there may be no industry members left.

What strategy will ensure survival by industry members? The synopsis above makes it obvious that participation is the key to survival. The industry, with government cooperation, must develop an innovative approach to the problem. Five policy option alternatives follow.

Five Options

Option 1. Continue competitive procurement. In other words, do nothing. Allow the four primes to compete for fewer programs fewer airframes, and fewer resources.

Option 2. Encourage the continued trend toward contractor teaming to allow as many to survive in the industry as possible. A warm production base, strides in technology, and increases in international sales will result in fewer, but stronger, competitors.

Option 3. Subsidize the industry to ensure viability of manufacturers, and to continue U.S. leadership in advanced technology and research in the military rotary wing/tilt wing industry.

Option 4. Nationalize manufacturers, as has been done in Britain and France. In essence, establish controlled nationalized teaming.

Option 5. Combine options above. Merge or team two manufacturers, and contract R&D with the remaining, to keep the entire industry base warm and alive.

Option 1 is not viable in the current market environment. With the number of programs reduced, the production quantities reduced, and the programs remaining evisioned to be the only programs coming into existence over the next 10-20 years, the success of one vendor in one program may mean the demise of the other three. For example, if V-22 is canceled and LH requirements remain at 1,292 units as forecast, if the LH is competed, it is unlikely the losers could survive until a future program comes forth.

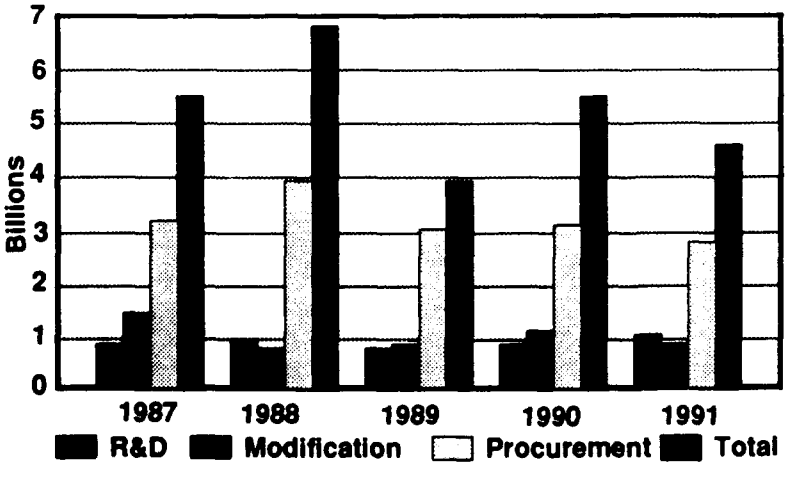
Option 3, with no complementary action, is unsatisfactory. The military helicopter industry is vital to national defense. Industry viability is in the public interest and satisfies a basic rule of government industrial policy and market interference. The current budget situation and value placed on competition in the United States preclude this option.

Option 4, nationalized teaming, also is not acceptable in the current competitive and fiscal environment in the United States. However, if industry viability becomes questionable, this option will become attractive.

Option 5, teaming of two manufacturers, combined with R&D contracts to the remaining to ensure survival, is questionable from a government policy viewpoint for the same reasons as Options 3 and 4, and is suspect as well from a viable business strategy viewpoint.

Option 2, contractor teaming, holds the answer for industry success and growth. The benefits, although changing over time, far outweigh the negatives. I will use the V-22 and LH as examples of the application and benefits of teaming.

FIGURE 1. U.S. DEFENSE HELICOPTER SPENDING 1987-1991



Rotor & Wing International, Feb. 1991

Dual Production

The LH was originally envisioned to be a program of 4,000 airframes in two models, a utility aircraft and a scout/attack aircraft. With large production quantities, the government envisioned dual production and several benefits.

—Cost reduction through team competition to FSD, with the winning team continuing FSD. After FSD, and initial production, production competition would take place, resulting in further cost reduction

—Greater investment funds, greater R&D base available

—Reduced duplication of critical skills, capital investment

—Higher level of overall product excellence

—Overall economies of scale

—Second source, warm production base, mobilization capability.

The contractor teams, Bell-Boeing, Bell-MDHC, and Boeing-Sikorsky, also recognized several advantages.

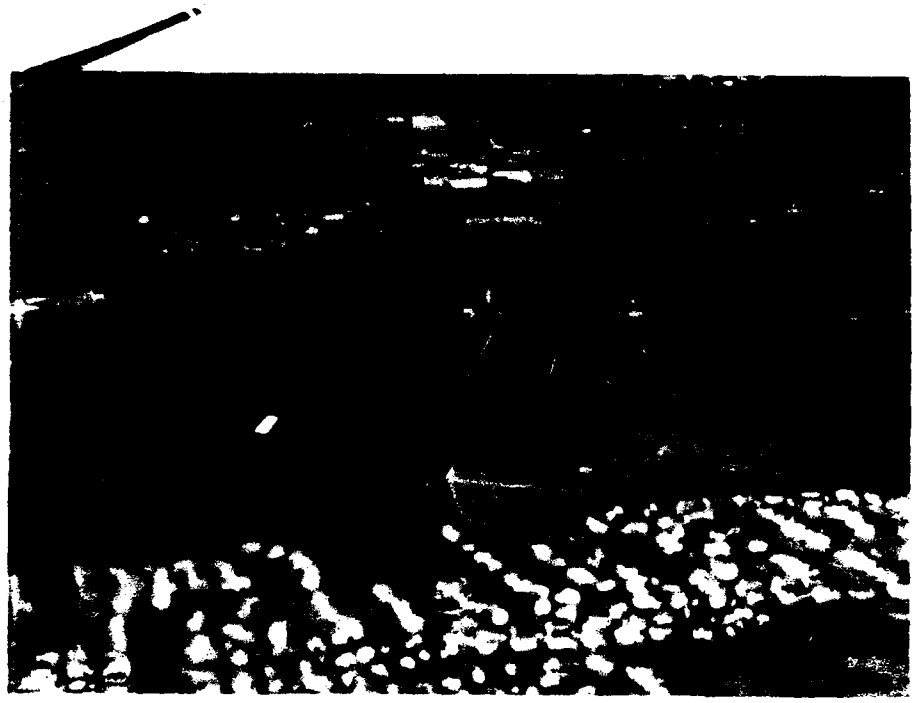
—Pooled resources

—Reduced financial risk

—Reduced technical risk

—Strengthened competitive position

—Optimized technical expertise.



The V-22 Osprey is the Marine Corps next-generation, ship-to-shore assault aircraft and will replace the CH-46.

While teaming 'sometime-competitors' poses significant problems, they must be overcome if the industry is to survive

In the LH program, however, when requirements dropped to 1,292 units, even the government realized that dual production was no longer feasible. Now, the winning team will coproduce, with each team member manufacturing in its area of expertise. Many of the government and all of the contractor benefits are still realized, but the fundamental government reason for contractor teaming—price competition—is eliminated with coproduction. With coproduction, the three principal cost elements, non-recurring tooling, recurring airframe production, and recurring armament production, will be reduced significantly. In coproduction the cost of these three elements is estimated to be 33 percent less than either dual production or sole competition.[8]

Areas of Concern

Teaming and coproduction brings with it some areas of concern.

—Members have problems with communication and cooperation after contract award when there is no common goal to win.

—Team goals sometimes take second priority to company goals.

—Teams cannot keep proprietary information completely separated, particulary when team members on one program are competitors on another.

—Companies sometimes put less than the best foot forward in human talent.

—The potential political clout of multimember teams with resulting huge constituencies is a concern.

—Excessive teaming may result in homogenizing of technology.

While the Bell-Boeing relationship on the V-22 has not progressed without some of the problems mentioned above, overall the teaming arrangement has been quite successful. One reason for that success can be attributed to the lack of historic head-to-head competition between Bell and Boeing in the industry. The team members who lined up for the LH competition, however, Boeing-Sikorsky and Bell-MDHC, have been involved in direct competition in years past. Boeing and Sikorsky competed for the UTTAS, which Sikorsky won; Bell and MDHC (formerly Hughes Helicopters) competed for the Army's observation helicopter program, and compete directly in the civil helicopter industry. The problems of proprietary information and team goals will become more significant given historic competitive relationships. How the teaming arrangement for the AH-66 evolves may provide the answer for the future of teaming arrangements in the industry.

Other strategies can and should be used by manufacturers to make them more viable, and many of the following have been practiced throughout industry. Complementing strategies include licensing off-shore production and/or technology, initiating joint production ventures with off-shore firms, diversifying manufacturing for other aerospace segments, and creating a modernization market for fielded programs. In addition, government contracting of critical R&D efforts must not be ruled out, particularly if survival of this critical national defense industry is in question.

Surviving

In summary, the U.S. military helicopter industry will not survive in its current configuration, given generally accepted forecasts for future procurement. However, as illustrated in the analysis above, the principal hope for the industry will come from contractor teaming, as is being done currently with Bell-Boeing and the V-22, and the teams of Boeing-Sikorsky and Bell-MDHC on the Light Helicopter. While teaming "sometime-competitors" poses significant problems, the problems must be overcome if the industry is to survive.

In addition, government assistance in the form of advanced technology research and development, administered conditionally on the principal of additionality, should not only assist with survival, but should make the U.S. makers more competitive in

(Continued on page 11)

EXPERIENCING DIVERSITY

Managing the 2005 Work Force

Dr. Mary-jo Hall

Managing the 2005 Work Force is a new three-hour workshop developed as part of the Program Management Course (PMC) electives program at the Defense Systems Management College, Ft. Belvoir, Virginia. Objectives are:

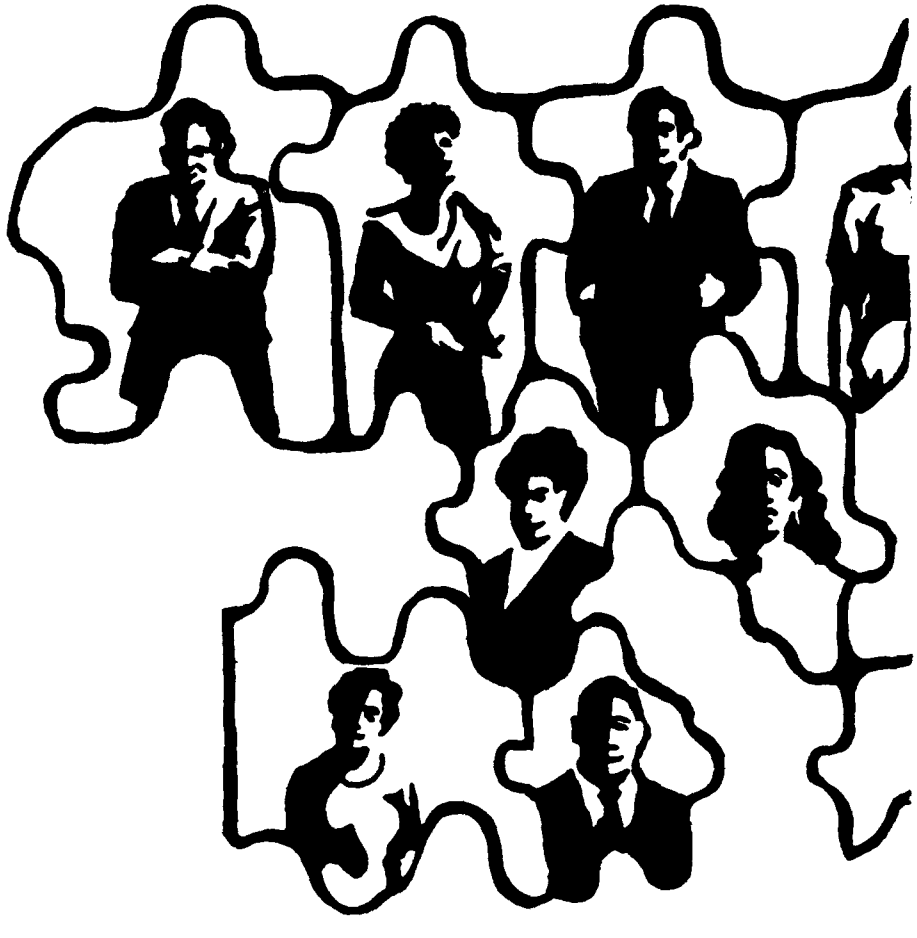
—Help participants become aware of the work force trends as indicated by demographic data

—Help participants become aware of what a diverse work force is and how it relates to productivity

—Have participants experience through several exercises some barriers to productivity in the organizational setting

—Have participants develop a plan of action for assessing their organizations' awareness and acceptance of diversity.

This article presents an overview of elements within the workshop. Additional resources and a reading list are available from the author.



Utilize Talents

In 1987, the Hudson Institute published results of *Workforce 2000*, a study commissioned by the Department of Labor. The purpose was to study and document major American labor-market trends to help public policy-makers adjust to changes in economic and social conditions that would influence the direction of policies and programs. It was anticipated the end-result would be "...an economically competitive America that fully utilizes talents and skills of all its citizens." (Johnston, 1987.)

The study posits there will be four major trends shaping the economic scenario of America as this century ends. These are:

—The American economy should grow at a relatively healthy pace

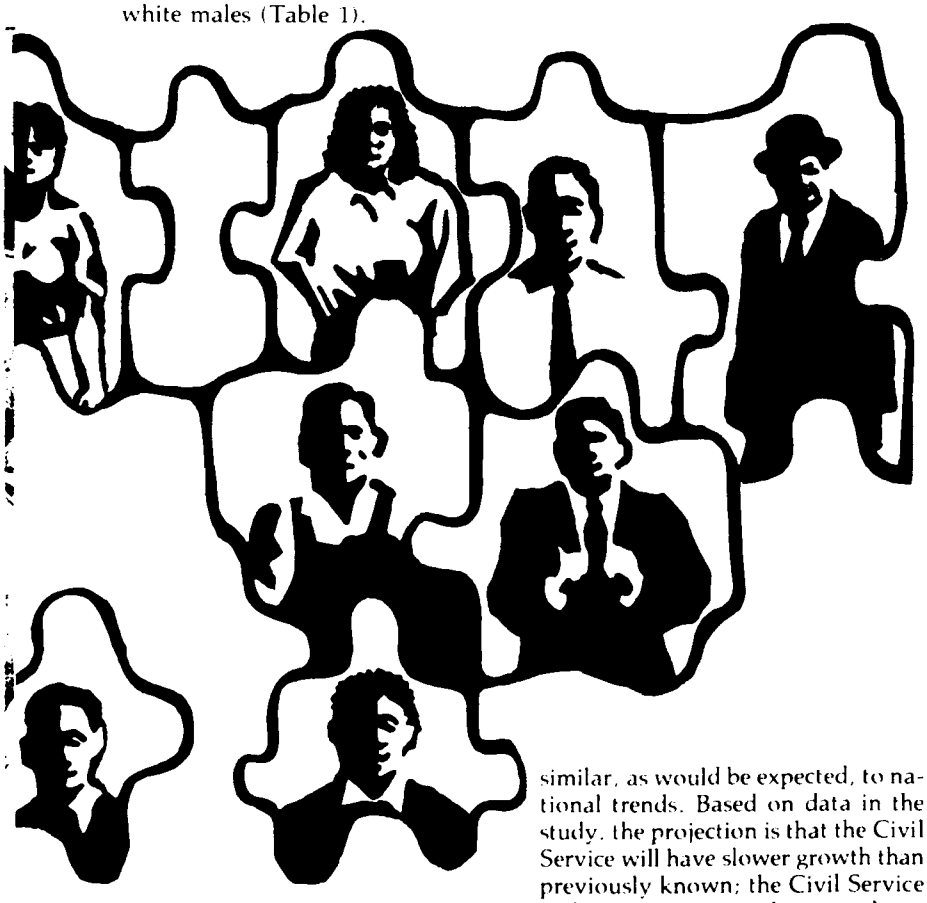
Dr. Hall is a professor of management at the Defense Systems Management College. She developed the workshop, Managing the 2005 Work Force.

—The U.S. manufacturing will be a much smaller share of the economy in the year 2000 than it is today

—The work force will grow slowly, becoming older and more female

—The new jobs in service industries will demand much higher skill levels than the jobs of today. (Johnston, 1987.)

This research reflects other studies elaborating on the "baby boom to baby bust" idea, "graying" of the work force, and change in the demographic mix of the population. (*Fortune*, June 17, 1991, p.12.) One key aspect of the demographic trend is that only 15 percent of *new* entrants into the workforce will be white males (Table 1).



Civil Service 2000

A year after publication of *Workforce 2000*, The Office of Personnel Management commissioned a study by the Hudson Institute to focus on trends within the federal work force. Findings were published in *Civil Service 2000* and were similar, as would be expected, to national trends. Based on data in the study, the projection is that the Civil Service will have slower growth than previously known; the Civil Service will become increasingly an employer of women with an increasingly older work force; and the Civil Service will have a shift in demographics.

One of the primary projections of *Civil Service 2000* is that 50 percent of workers who will be in the Civil Service at the end of this century are already on the work rolls. Implications for this fact are many and varied in terms of training for new skills, benefits, promotion rates, etc. Even though the report showed that presently the government falls behind in hiring women, data indicated that presently women comprise 50 percent of government personnel specialists, contract specialists, budget analysts and program analysts.

Combining data and projected trends from these two studies, the important question for a manager in the government becomes: "What are the implications from this data and why are they important to me?"

Productivity is an issue in many organizations. However, in the acquisition arena that the Defense Systems Management College serves the productivity issue is compounded by a constantly changing resources environment—people and money.

How does a program manager create an environment where employees are motivated to focus on customer satisfaction and provide a quality product or service, especially when employees have a variety of needs, values and attitudes?

How does the program manager of the future anticipate changes in the work place based on changing demographics, and capitalize on these changes to build an effective workteam?

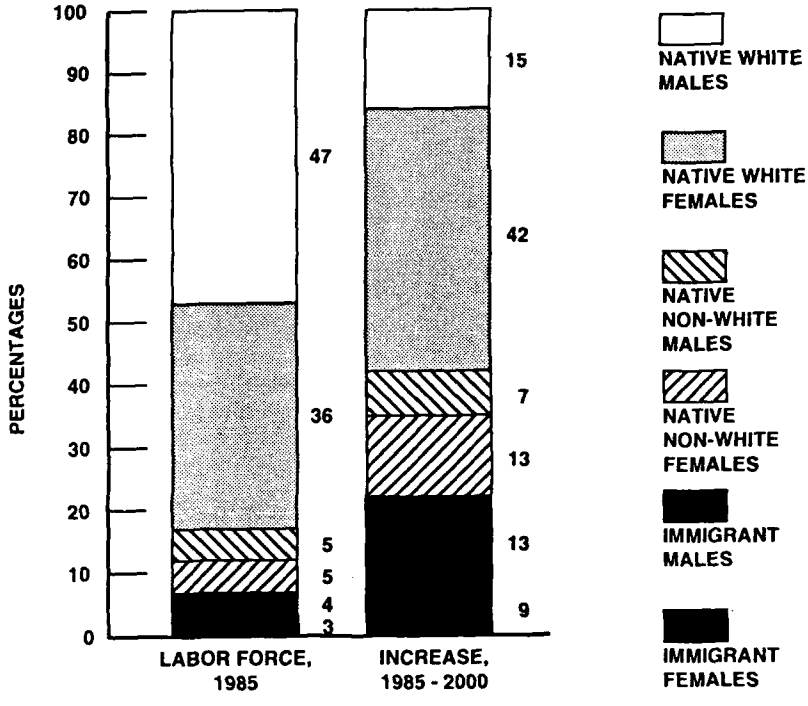
How does a program manager reward team members?

Individual Uniqueness

One key aspect of creating an environment where workers are motivated is recognition of team members in terms of individual uniqueness; i.e., who they are and where they are coming from in terms of education and experience, their values, beliefs and attitudes, and how they relate to the world in terms of perceptions.

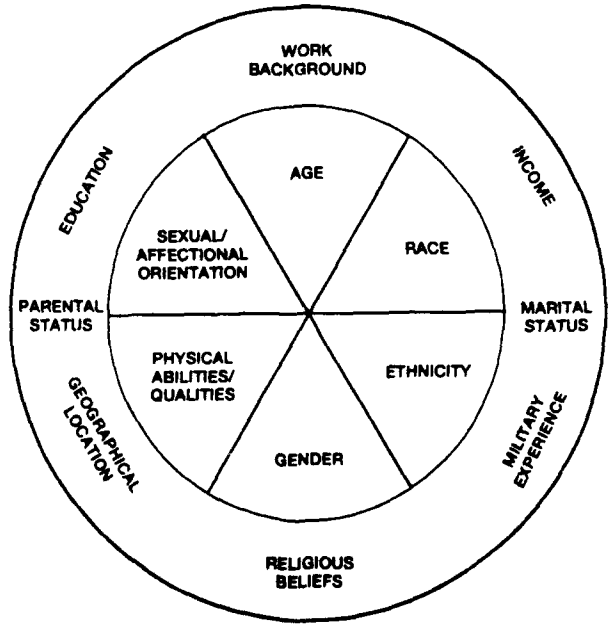
Xerox, Honeywell, Mobil, Ethicon and 3-M are among companies realizing that, in order to increase productivity, the demographics of their employees should reflect demographics of their customers. (Geber, 1990; Thomas, 1990.) These companies use a marketing strategy emphasizing knowing the customers by examining their differences, internally and externally.

TABLE 1. MOST NEW ENTRANTS TO THE LABOR FORCE WILL BE NON-WHITE, FEMALE OR IMMIGRANT.



Source: Hudson Institute.

TABLE 2. PRIMARY AND SECONDARY DIMENSIONS



Source: Workforce America (1991) Loden and Rosener.

These organizations have programs to promote the acceptance of differences, referred to as "work force diversity." Managing diversity is defined as openly supporting and encouraging ideas from all people whether their beliefs, personal lifestyles, race, gender or age are different from, or similar to, ours.

Loden and Rosener in their book, *Workforce America!* state there are primary dimensions and secondary dimensions contributing to an individual's uniqueness, thus to work force diversity and, ultimately, to organization productivity.

Primary dimensions of diversity are age, ethnicity, gender, physical abilities, race and sexual orientation.

Secondary dimensions are education, geographical location, income, marital status, religious beliefs and work experience.

These dimensions, which provide individuals with a unique perspective on all aspects of their lives, are graphically displayed in what Loden and Rosener call the "Diversity Wheel." (Table 2.)

Each person relates to the world based on a unique set of dimensions. Individuals relate to other people in terms of how different they are in these dimensions. This is referred to as "otherness." For every person, the unique combination of dimensions affects individual values, attitudes, expectations, priorities, motivation, and productivity. All affect the organization.

This approach to explain why diversity exists may seem simple at the macro-level. Yet, when examined closely, implications are profound for program managers in the acquisition community, and for supervisors at all levels. Organizational realities today differ from past ones and will change as the year 2000 nears. Quality services and products are watchwords of the competitive marketplace as downsizing becomes a reality.

The *Workforce 2000* scenario indicates that a labor market homogeneous in terms of demographics is out of the question. Diverse workers expecting more than tolerance or indifference from the traditional model are growing in critical proportions.

According to Roosevelt Thomas, American Institute for Managing Diversity, Morehouse College, many diverse workers are not interested in being assimilated into a "melting pot" but want to be accepted for the unique qualities they bring to a work team.

The key is for managers to welcome the diversity scenario as a challenge. They should view the increasing diversity in the labor market as an opportunity to gain new ideas, increase innovation in methodologies, and gain opportunities to broaden perspective of the work team; also, to increase the bottom line, whether a quality product to satisfy the user's requirement or a quality service to increase team effectiveness.

How does this happen?

Be Aware

As many learning models advise, the first step is to increase one's *awareness* of this diversity or "otherness." How do you create awareness opportunities?

One way is to look at your unique dimensions of diversity and literally put yourself on the diversity wheel. From this analysis, you can reflect on biases and values germane to your dimensions. Another way is to look at your work team, office, etc.

Perry Smith says in his article, "Be a Better Leader":

> The next time you hold a meeting of your key subordinates, look around and see who is in attendance. If the room is full of white males with only a very few women and a very few members of minority groups, you have a problem. (1991.)

Another part of personal awareness is to learn as much as possible about stereotypes and focus on ways to avoid them. One exercise in Managing the 2005 Work Force workshop has participants spend 10-15 minutes listing stereotypes associated with the following labels: civilian, military, black, white, female, male, older employee, younger employee and handicapped employee.

Learning from this experience points out the following aspects of stereotypes:

—They are numerous and prevalent in most groups

—They are often caustic and derogatory, based on prejudice

—They are typically distorted generalizations that do not consider specifics of a situation

—They block out information

—They pigeonhole a person or group

—They limit the view of people's qualities

—If verbalized, or allowed to surface in any way, they are legitimized and, once legitimized, are difficult to control.

The primary reason for educating yourself on stereotypes is that when a person does not know another person, the two tend to relate in terms of sterotypes. (Kanter, 1978.)

If a new program manager or any supervisor has 15-20 years of work experience with groups demograhically homogeneous, then relating to a work team not fitting this model would be a challenge. Many managers and supervisors in government and industry are neither prepared nor trained to deal with this diversity.

Office Barriers

The third aspect of making yourself personally aware is consciously learning about barriers in your environment that hinder full participation of all workers.

The DSMC workshop has an exercise where barriers are listed by participants, together with an action plan to remove them. One part of the exercise is to view a poster, stressing "quality as an attitude," which frequently is seen on walls in organizations espousing total quality management.

Closer inspection reveals a man and a boy surrounded by myriad faces—primarily white males. Out of the many small pictures surrounding the two central figures there are scenes with females and no distinguishable scenes of blacks; one woman is baking a cake and the other appears to be a school teacher.

What is this poster really saying? What does it say to different people?

After this exercise, one participant said he saw the poster frequently; however, he never noticed it speaks primarily to one type of team member—the white male.

Other office barriers suggested by participants include the frequent use of innuendo and jokes degrading certain dimensions of diversity; the frequent use of having only competitive team sports for social activities; and the perception that different rules exist for different groups. Another barrier, promoted by different communication styles, is including certain people in group discussions and ex-

(Continued on page 27)

THE AIR FORCE LESSONS LEARNED PROGRAM NEEDS YOU

Pat Nickell
Bob Kerr

c-cen-tu-ate the positive, e-lim-i-nate the negative...." We're sure you recognize these as words of an old song, but it also is the principle on which the Lessons Learned Program is based.

The spiraling cost, limited-funds world is a reality today that presents new challenges to supporting our fighting forces. Because of constantly shrinking budgets, we are forced to find new and improved ways of doing business and ensure that we don't repeat mistakes.

The purpose of the Lessons Learned Program is to gather and record experiences, lessons learned, both positive and negative, conduct research necessary to verify these experiences are accurate, and make them available for use by Department of Defense (DOD) employees and certified government contractors. We *transfer experience from those who have it to those who need it.*

Lessons learned are not to be construed as criticism of prime contractors, equipment manufacturers or program offices; nor are they necessarily operational deficiencies. A lesson learned is simply a recorded experience of value in conducting future programs or modifications.

Memory Bank Is Current

The Lessons Learned staff maintains this corporate memory bank of past program experiences. The data bank contains not only Air Force lessons, but Army and Navy lessons. All lessons are revalidated annually to ensure they are accurate and up-to-date. This data base is located at Wright-Patterson Air Force Base, Ohio, and managed by the Acquisition Logistics Division's (ALD) Air Force Lessons Learned Program Office.

The data base is a comprehensive, real-time, on-line, full text, interactive information storage and retrieval system. It is divided into 65 separate "impact areas" such as contract management, artificial intelligence, maintenance engineering, logistics management information support, life-cycle cost, logistics support analysis and total quality management, to name a few. New impact areas can be added. Searches can be made by impact area, keyword or program phase.

Lessons Learned has developed input sources, validation procedures and an automated storage and retrieval system to provide feedback from flightline mechanic to designer. One objective is to close the gap between Air Force organizations and the defense industry by documenting experiences of users and maintainers of systems and equipment and feeding this information to designers for future reference.

Technical and Non-technical

There are two categories of lessons—technical and non-technical. Technical lessons pertain to design features of a system or equipment that influence reliability, maintainability, availability and support costs and include supporting operational or test software.

Non-technical lessons deal with program management and logistics support planning influences like procedural deficiencies or improvements, time-phasing of program office actions, quality assurance, and other logistics support considerations.

While most lessons are acquisition oriented, we are expanding to include lessons in operational areas, like the Blue Two Visit Program. Blue Two is named after Air Force blue-suited, two-stripers that allows contractors to work side-by-side with airmen on base flightlines, worldwide, to gain a better understanding of how the systems they design perform in

Ms. Nickell was a member of the Lessons Learned staff at Wright-Patterson Air Force Base, Ohio. Mr. Kerr is the data base manager of the Lessons Learned Program.

operational conditions. Experiences like these improve future designs. The bottom line is that lessons learned need to be applied in our daily work.

Some lessons learned can save money and man-hours by early identification of problems that can reduce repair times, by providing helpful information for request for proposal requirements, and by saving money in design that could eliminate configuring the same mission items repeatedly. Using lessons learned is a key to improved reliability, supportability and readiness of present and future weapon systems. Lessons learned can be profitably applied in every step of system design, development and production, and in planning for support of the system after deployment. We will be able to get more from limited resources by *accentuating the positive experiences and eliminating the negative ones.*

User Feedback

User feedback is an important tool the staff uses to improve their services and the quality of lessons entered into the data bank. Feedback is obtained by using questionnaires and by phone calls to program users.

The Lessons Learned staff has developed a P.C. version of the data bank called the Automated Lessons Learned Capture and Retrieval System (ALLCARS). This version, on disks, can be run on *your* P.C. Disks will be updated periodically for currency.

We invite you to submit potential lessons learned (PLL) to us or to become a potential lesson validator. When writing lessons for submission, there are criteria to be followed. The proper format consists of a Topic, Lesson Learned, Problem, Discussion, and Recommended Action statements. Two areas presenting the most problems for writers are the Lessons Learned and Recommended Action statements. The Lesson Learned statement must show a cause and effect relationship. For example: "Inadequately designed heat removal systems and lack of status monitoring (cause) of critical equipment cooling can result in data errors and equipment failure or damage (effect)."

The Recommended Action statement must say "who" should take "what" action and "when" the action should be taken.

The Lessons Learned Office has forms for submitting PLLs or they can be submitted electronically through on-line access. All PLLs go through a validation process to ensure accuracy of information. A validator, then, is an individual (or organization) with expertise in the subject area of the PLL and agrees to do necessary research to ensure validity of information (validate) contained in the PLL. This valuable program will be enhanced through *your* participation.

On-line Access

You may request on-line access to the data base or take advantage of other services of the Air Force Lessons Learned Program Office by contacting ALD/LSE, Wright-Patterson AFB, Ohio, 45433-5000; Defense Systems Network (DSN) 785-9689 or Commercial (513) 255-9689. You may leave a message after duty hours by calling DSN 785-5238 or Commercial (513) 255-5238. We will return your call the next duty day.

You are the key we need to enhance this important program. Will you become involved?

DEFENSE HELICOPTER INDUSTRY CONTRACTOR TEAMING

(Continued from page 5)

the lucrative future markets of the Far East.

Endnotes

1. David S. Harvey, "U.S. Defense Helicopters: The Picture's Not All Bad," *Rotor & Wing International*, Feb. 1991, p. 28.

2. William J. Baumol, Alan S. Blinder, *Economics, Principles and Policies*, (Harcourt, Brace, Jovanovich: New York: 1988), p. 617.

3. United States, Government Accounting Office, *Helicopter Programs* (Washington: GPO, 1990), p. 5.

4. Mark Lambert, "Better Times for U.S. Helicopter Makers," *Interavia*, 4 1990, p. 329.

5. Harvey, p. 29.

6. *Ibid*, p. 29.

7. Lambert, p. 333.

8. William E. Shafer, *Analysis of a Coproduction Acquisition Strategy for the Light Helicopter Program (LH)*, (Alexandria: Institute for Defense Awareness, 1990), p. viii.

Works Cited

Baumol, William J., and Blinder, Alan S., *Economics, Principles and Policies*. New York: Harcourt, Brace, Jovanovich, 1988.

Forecast International. *Aircraft Forecast, Civil and Military*. Newtown, Ct.: 1989.

Harvey, David S., "U.S. Defense Helicopters: The Picture's Not All Bad." *Rotor and Wing International*. Feb. 1991: 25-30.

Lambert, Mark. "Better Times for Helicopter Makers." *Interavia Aerospace Review*. 4 1990: 329-334.

Shafer, William E., *Analysis of a Coproduction Acquisition Strategy for the Light Helicopter Program*. Alexandria: Institute for Defense Awareness, April 1990.

United States. Department of Commerce. *1991 U.S. Industrial Outlook*. Washington: GPO, December 1990.

United States. Government Accounting Office. *Helicopter Programs*. Washington: Government Printing Office, December 1990.

LEPER AND WHIPPING BOY

Unique Challenges of Standards Management

Lieutenant Commander Stephen Kasputis, USN

When someone asks what my job is for the Navy, I say I am the designated leper and whipping boy. I work for the Navy Standard Signal Processor shop, attempting to introduce a new standard signal processor to the Navy. There are valid arguments for and against the use of any standard. This is not intended to support either side but, rather, point out unique problems faced in one small part of "standards" management.

Introduction of a new standard signal processor is not a pretty thing to watch. Most major program managers tend to see only negative aspects of standards. They are, at best, hesitant to use standards, especially a new standard, in their systems. It seems at times that they run away from standards and hide behind every excuse conceivable. In this respect, being a representative of the Standards Program Office is like being a leper.

One occasionally gets the feeling that before approaching the user program offices, you should tie a bell around your neck and yell "Unclean! Unclean!" to warn of your approach. Another axiom of this job is when a program does use a new standard in the system, it provides a convenient scapegoat.

The program office or prime system developer can blame government furnished equipment (GFE) for

Lieutenant Commander Kasputis serves with the Naval Sea Systems Command, Washington, D.C.

many system woes. In this respect, my job is very much like being a whipping boy.

Sense of Loss

Reasons for unpopularity of a new standard are probably involved enough to justify several doctoral dissertations in psychology or management. However, there are a few obvious choices. Chief among them is the sense of loss of some control by the program manager who has been directed to use a standard being developed in parallel with his system.

Performance shortfalls of the emerging standard, delays in development schedule, or procurement cost increases could have serious adverse effects on his program. Program managers usually perceive they have little or no influence over the standard's development and that accepting this equipment as GFE is, in reality, just adding government furnished risk.

Compounding the perceived loss of control by the weapon system program manager is this fact: His prime development contractor is usually claiming to have a better way to solve the problem.

Every defense contractor has a faster, cheaper, more efficient method of doing whatever has to be done, and will espouse merits of the solution at every opportunity. Several possibilities exist for the prime-developer motivation. Possibly there is a competing processor in some stage of development for which they wish to create or expand a market.

Another possibility is a wish to expand their business base, in this case to include signal processors. Developing a processor for the system they are creating would be a good way to break into the marketplace. Whatever the reason, this hard sell is only to be expected.

The use of a standard product becomes even less inviting to a program manager constantly exposed to the "hard sell."

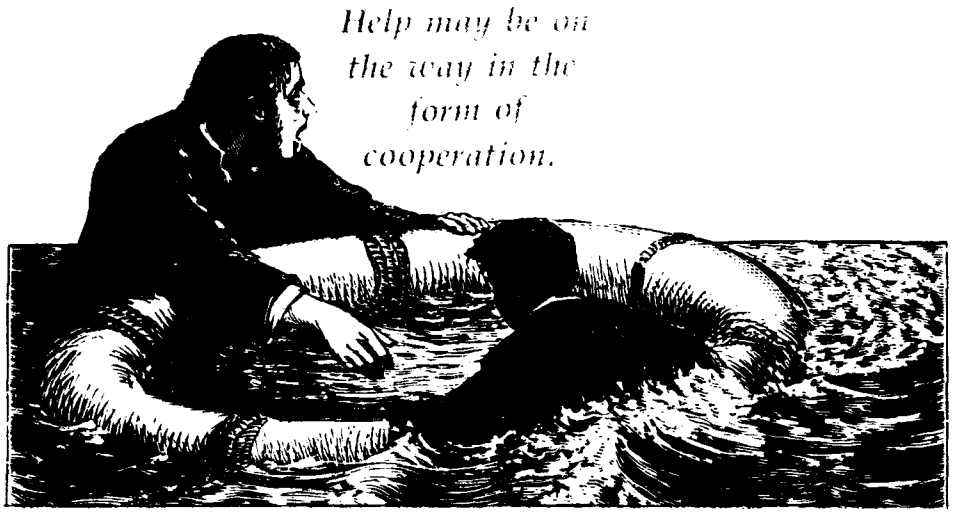
It is not wise to beat up someone in the same boat.

Catch 22

In trying to gain acceptance for our product, the Standards Program Office constantly has a "Catch 22" situation. Each user program office wants the latest technology available for its program. From the point of view of the user program, a standard in development for any length of time obviously cannot embody latest technology.

The "Catch 22" comes from the other argument used by the same program offices; the signal processor still in development is not mature enough to incorporate into their system without considerable risk.

They apparently want a fully tested, drop-in box whose performance has been proved to meet their requirements, which is easier to program than your VCR, has a complete set of fully tested programming and debug tools, has their defined interfaces, is fully documented, and is available within days of the first laboratory demonstration of the technology it employs.



There is a contradiction here between the maturity and level of technology desired in a standard. This contradiction, however, seems to be *obvious* to very few, and standards suffer from the fact that they cannot satisfy that contradiction.

Age and Ability

The argument about using a particular technology is always on the age of that technology, and not on its ability to do the job now and in the future. If a system is labeled as containing old technology, it is immediately and unquestionably also labeled as something to be avoided. This may be our love for new technology and constant quest to "build a better mousetrap."

The surprising fact is that all levels of managers and policy-makers, almost without exception, echo the same theme. Even requirements analysts seem to assume automatically that if a system does not have the latest technology, it cannot possibly meet approved requirements.

The reasons for existence for the whipping boy aspects of this job may be nearly as numerous as those for the leper aspects. At first they seem obvious, but have subtleties not easily uncovered or explained. The natural response of finger-pointing usually has compound reasons behind it.

Consider first the system prime developer. Some programs are living the legacy of the fixed-price development contract era. For fixed-price development contracts that were to incorporate the use of standards, delivery dates and performance parameters of the standards (to be provided as GFE) are typically written into the contract. For any schedule or performance deficiencies of the GFE that the contractor can prove, a claim for compensation can be made.

For developments occurring under a cost-plus type contract, claimed deficiencies in GFE can be used in an attempt to hide shortfalls in the prime's development effort. Even if the prime's efforts are meeting expected schedule and performance achievements, deficiencies in GFE can be turned into extra funded effort for them as they need to develop "workarounds." This at least keeps a few employees working longer and may provide extra profit.

Another possible motive for a prime development contractor to find fault with a GFE processor is that he has a competing processor he hopes to sell to the government. This is identical to one of the reasons I discussed for a standard's unpopularity. It is simply occurring with the weapon system program in a different situation than I discussed before. Even if the contractor has no processor of his own that he hopes to substitute immediately, changing from the designated standard processor will again, at least, provide more work for employees.

Poor Communication

Compounding the effect of the prime contractor using GFE deficiencies to his advantage is the sad fact that communication among government program offices is usually much worse than communication between a program office and the prime developer. The contractor's version of problems with the GFE and their proposed solutions are, therefore, more efficiently communicated than are rebuttals or alternate solutions that the standards program office might offer.

This results in the standard not only being the whipping boy of contractors but of other program offices. Add to this the voice of those arguing against using standards earlier in the program, and were waiting to say "I told you so," and you have an effective federation exercising the whipping-boy aspects of my job.

For many reasons, a few of which I outlined above, my current billet will remain, at least in the near term, that of designated leper and whipping boy.

While the wounds of a whipping boy may heal, leprosy has no known cure. A leper's only hope for a better life is through better social acceptance. But the opinions and attitudes of society, even a relatively small one like our acquisition community, change slowly.

Therefore, I hold little hope for improvement in the acceptance of any new processing standard in the near future. Unless acceptance is eventually achieved, the job of managing a standards program will remain in a unique social and managerial position in the acquisition system.

CHANGE OF COMMAND AND RETIREMENT

The Hon. Donald J. Yockey, Under Secretary of Defense for Acquisition, officiated July 26, 1991, when Rear Admiral William L. Vincent, USN, became the 10th Commandant of the Defense Systems Management College. On the right is Major General Lynn H. Stevens, USA, Commandant from April 29, 1988, until July 26, 1991, who has retired from active military service.

Receiving his wings in 1964, Rear Admiral Vincent subsequently served tours in VP-40, NAS North Island, as Plane Commander flying the SP-5B; VT-28 as a TS-2A flight instructor; and VP-17 as a Department Head and Plane Mission Commander. During these tours he participated in five Southeast Asia deployments flying Market Time Operations. In addition, he attended the Naval Postgraduate School where he was awarded a master's degree in aeronautical engineering; the Naval War College where he was graduated with distinction and awarded the Mindendorf Award for Tactical Research; and the Defense Systems Management College. During a tour at Naval Air Systems Command, he served as the Tactical Air Reconnaissance Class Desk Officer.

Rear Admiral Vincent assumed command of VP-44, NAS Brunswick, in 1978. During his command, VP-44 transitioned to the P-3C Update II and deployed to NAS Keflavik, Iceland. The squadron received several awards including the Meritorious Unit Commendation, Battle "E", Golden Wrench, and Silver Anchor. After his command tour, he completed tours as Chief Staff Officer, Patrol Wing FIVE; Naval Armaments Officer, U.S. Mission NATO, and Head of the Air ASW Branch, Office of Naval Warfare on the staff of the Chief of Naval Operations. During this last assignment, he was selected for major command.

The new Commandant reported to Patrol Wing TWO, NAS Barbers Point, as Commander in 1984. During this tour, two squadrons completed transition to the P-3C Mod, and the Wing participated in highly successful ASW operations in the Pacific operating area. He reported to Naval Air Systems Command in October 1985 as P-3 Program Manager. Rear Admiral Vincent served as the Program Director, Air, for ASW and Assault Programs until April 1990, when he was named Program Executive Officer for Air ASW, Assault, and Special Missions Programs.

WHY LEADERS CAN'T LEAD

The Unconscious Conspiracy Continues
Warren Bennis
(The Jossey-Bass Management Series, 1989, 169 pp.)

This book is intended for people in a position for leadership, or aspiring to such a position—for anyone interested in the future of our society. The author, Warren Bennis, recognizes the changes in the 1980s were a result of what happened in the 1960s and 1970s.

The unconscious conspiracy in contemporary society according to Bennis, has "prevented leaders—no matter what their original vision—from taking charge and making changes." Today, it is more difficult to be a leader in America than it was in 1970, when Bennis wrote *The Unconscious Conspiracy: Why Leaders Can't Lead*. Most Americans readily believe we need leaders in the 1000s but, according to Bennis, leaders never have been held in lower regard than they are now. Most of our leaders feel helpless to affect anything beyond their immediate environment, so they are retreating into an ever-contracting private world.

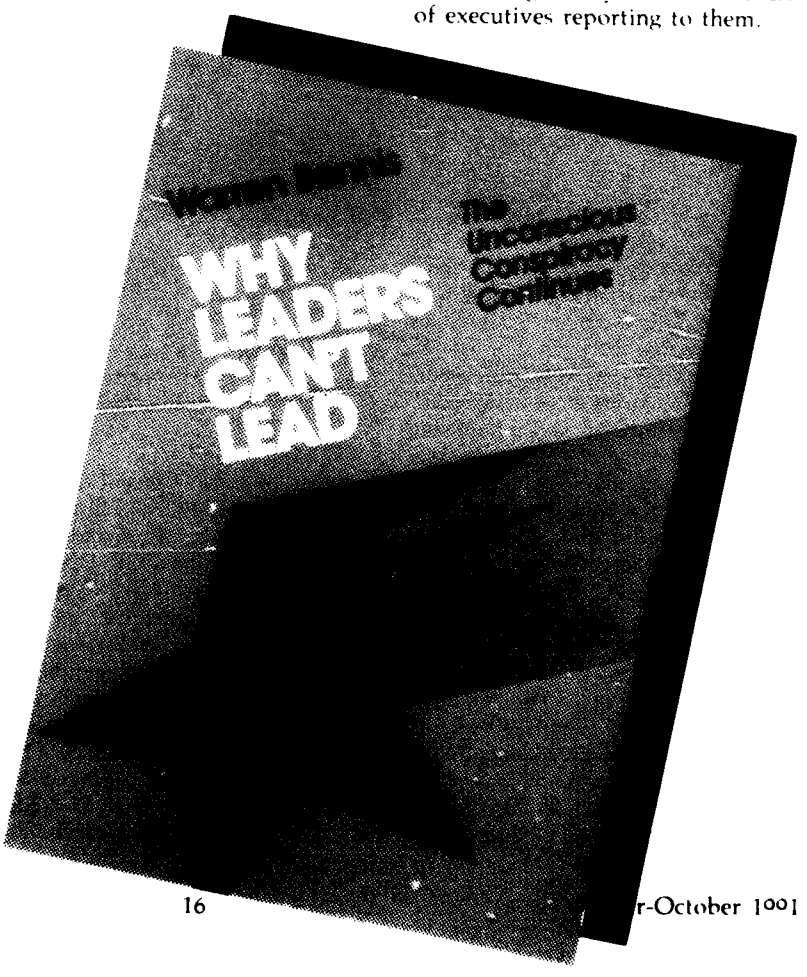
Mr. Bennis identifies the problems facing our leaders today and describes how to deal with troublesome issues. He hopes the book will make each reader aware of the possibilities for change in an organization and spur him her to take responsibility for change. This is the first step in taking charge—in becoming a leader.

Mr. Bennis is a distinguished professor of business administration at the University of Southern California. Before serving as president of the University of Cincinnati and executive vice president of the State University of New York, he was successor to Douglas McGregor at the Sloan School of Management, Massachusetts Institute of Technology. He has served on the faculties at Harvard and Boston Universities. He is the author of 15 books including the best-selling *Leaders: The Strategies for Taking Charge* (1985, with B. Nanus), and more than 500 articles. Bennis was an advisor to four U.S. presidents and now serves as a corporate consultant.

The author hopes the book will give readers practical ideas on how to deal with difficult issues. Consideration of ideas from each part of the book, presented below, will provide insight into its nature and scope.

Part One: The Unconscious Conspiracy and How to Confound It

—Top men and woman new to the burdens of high position may become over-worked, and seriously undermine the legitimacy and effectiveness of executives reporting to them.



David D. Acker, our reviewer, serves in the Research Directorate at the Defense Systems Management College.

—The leader must develop a sufficient climate of understanding so that the various publics on whom every present-day institutuion depends for its support, financial and moral, as well as the people who take its classes or work in its plants and offices, care about the institution and identify with its destiny.

—Routine work drives out nonroutine work and smothers creative planning.

—Many institutions are well managed, but poorly led. We collude in the unconscious conspiracy to immerse us in routine.

—Leaders are people who do the right thing; managers are people who do things right.

—American organizations are underled and overmanaged.

—There are four competencies evident in successful corporate leaders: management of attenion; management of meaning (to make dreams apparent to others); management of trust (constancy); and management of self (knowing one's skills and employing them effectively).

—Leaders know themselves; they know their strengths and nurture them.

—Change occurs in two primary ways: through trust and truth, and through dissent and conflict.

—The people who change not merely the content of a particular discipline but its practice and focus are not only innovators but leaders.

Part Two: A Society Without Dreams

—America is confused about what constitutes leadership. Some claim it derives automatically from power; some say it derives from a thorough comprehension of the nature of organizations.

—More leaders have been made in America by accident, circumstances, and sheer will than by all the leadership courses.

—Today, we do not dream but merely fantasize about money and things. As a dreamless sleep is death, a dreamless society is meaningless.

—As a nation cannot survive without virtue, it cannot progress without some common vision.

—At the moment, Americans don't seem to want leaders; we seem to prefer conspirators, and that is what we have. We seem destined to drift on dreamlessly, secure in our cocoons of self interest.

—We must have full and free communication regardless of rank and power.

—America has always been at war with itself. We always dreamt of community and democracy but always practiced individualism and capitalism. We have celebrated innocence but sought power.

—We have cut ourselves loose from our social bonds, and we're adrift, victims of our own hubris.

—The physical world is elegant in design, predictable in action, and fixed in purpose; the social world is vastly indignant, unpredictable and unfixed.

—Technologically, we're very advanced; psychologically, we're babes in the woods. We don't understand ourselves or anyone else very well.

—Today, no country has the kind of leadership it once had and now needs urgently.

—The new reliance on the courts has diminished the autonomy of institutions, but threatened the autonomy of the individual.

—We see the law less as an instrument of protection than as an instrument of assault.

—There is no such thing as the common good or the public interest today; there's only self-interest.

—Where have all the leaders gone? They are out there pleading, temporizing, trying to put out fires. They are playing leading characters in the dreamless society.

Part Three: Parts of Problem

—American cultural traditions define personality, achievement, and the purpose of human life in ways that shower the individual with glory.

—A corporation is a collective endeavor, and it needs collective wisdom, canniness, and vision of all its employees to function at an optimum level.

—Idols, such as CEOs, may start believing their own press. They get rid of dissenters or those who may have ideas.

—Contemporary corporate structure emerged by chance rather than by choice.

—The two-track CEO-COO structure is unworkable at the bottom. Although a clean and clear division of responsibilities may be put on paper, the responsibilities are indivisible and inextricably interwoven. The solution is to combine the responsibilities of the CEO and COO and assign them to the CEO.

—With less structure and more leadership, American business might begin to recover its nerve, energy and spunk; at present, there is little demand in the executive suites of our country, only an unnatural and unhealthy affection for the status quo.

—It has been the obsession of America's big businesses to watch the bottom line and the inability of businesses to see that its workers are their primary asset that has got them into trouble. Employees are a company asset not a primary liability.

—Power and property reside in people and the key measure—productivity—in companies and nations is attributable less to the quantity of their resources than to the quality of their people.

—Effective executives encourage (demand) dissent in the executive suite and surround themselves with people smart enought to know the truth and independent enough to speak it.

—What is important to management is the capacity to see things in wide perspective, to receive impressions and gain experiences directly, not vicariously.

—No business should be designed to win; it must be designed to grow, on both quantitative and qualitative levels.

—America has no leaders today. It has gamesmen—men and women

(Continued on page 33)

CONCURRENT ENGINEERING: A NEW INITIATIVE

Can It Solve DOD Acquisition Problems?

Dr. Jerome G. Lake

In a 1936 movie three workmen are shown building a house. One drops a brick from a scaffold, the brick hits a board which flips and hurdles a can of paint. The paint lands on the head of another worker. This worker turns and the board he is carrying hits a prop holding up another scaffold. And....This slapstick is intended to create laughter.

But off screen, in the development and production of complex systems, uncoordinated and undisciplined actions are no laughing matter. Such actions create unintended program cost overruns, development delays, non-producible designs and non-operable products.

Industry and government decision-makers recognize that U.S. companies must change the way products are developed and produced. Several initiatives have been taken to correct these deficiencies and return U.S. industry to world-class producer status. One such initiative is concurrent engineering.

Definitions

Concurrent engineering is defined in a 1988 Institute for Defense Analyses report (IDA Report R-338) as "a systematic approach to the integrated, concurrent design of products and their related processes, including manufacturing and support. This approach is intended to cause the developers, from the onset, to consider all elements of the product life cycle from conception through disposal, including quality, cost, schedule and user requirements."

Another definition was found in literature explaining the role of the Concurrent Engineering Directorate (CED) within the U.S. Army Communications-Electronics Command. According to CED, "Concurrent Engineering is the simultaneous and integrated engineering of all design, manufacturing, and support aspects of a product from concept through availability. It is a teaming concept. All of the people who normally get involved in the product come together as a team. They work together, trading ideas and ensuring what they decide now (like design decisions, or major product modifications) will not adversely affect what they have to do later (like manufacture in quality, or ensure support in the field). Everything is addressed simultaneously.

These are a sampling of definitions of concurrent engineering. They embody the major concerns expressed by advocates of concurrent engineering.

How will the product be produced?

How will it be supported?

How will it be tested?

How will it be used?

Purpose

Something needs to be done. The United States is losing markets and products are being produced with less quality than in countries like Japan. Product life cycles are becoming shorter. Labor costs are rising. Innovation is taking on greater importance. Major DOD weapon system program cancellations, such as the A-12, provide indications that major problems exist in product developments.

But, is concurrent engineering the answer? Is it really a new initiative? Is another approach really needed? Isn't this just another definition of systems engineering? If not, will concurrent engineering be able to accomplish what systems engineering has not been able to accomplish?

The purpose of this article is to answer these questions, and to raise the engineering community's awareness of the need to change the way systems engineering is practiced, and on what actions are being taken by the Department of Defense.

Concurrent Engineering Is it New? Is it Needed?

According to Evanczuk (High Performance Systems, April 1990) "in one form or another, concurrent engineering has been around for years. Indeed, many would call it sheer common sense development practice." The 1988 IDA report states their definition of concurrent engineering is considered the same as systems engineering (as envisioned in theory, not as practiced). Even a cursory review of Wilton P. Chase's 1974 book, *Management of System Engineering*, reveals that systems engineering as envisioned includes "the integrated, concurrent design of products and their related process."

Dr. Lake is a professor of systems engineering at the Defense Systems Engineering College.

Evidence suggests that concurrent engineering is not truly a new approach to engineering a system.

Why then should concurrent engineering be embraced by industry and the DOD? The simple answer is that it is needed. Based on meetings with industrial and government acquisition personnel there is agreement that systems engineering, as practiced, is broken. Current systems engineering practices result in fragmented, sequential design of the development, test verification, production deployment installation, operations, support, training and disposal functions of a system.

Such inefficiencies show up in program schedule slippages and cost overruns; in product designs that cannot be produced; in deployed products that cannot be supported, operated or maintained; in myriad waste and material disposal problems; and in major modifications of systems produced.

It is recognized that such inefficiencies entered into systems engineering practices to a large extent because of the emergence of engineering specialties (Chase, 1974, DSMC Report, 1991). These specialties are fondly called disciplines by engineers, and less fondly called "stovepipes" or "cults" (Chase, 1974) by critics.

Initial systems engineering concepts of the pre-1960s were based on "shaping a series of macro level interfaces" (Alberts, 1990). This approach was successful for the time. But, as the complexities of missile and computer age weapon systems evolved, interface control was not sufficient to assure integration of the diverse specialty inputs required to develop, produce and support a desirable and affordable product for the 1960s and beyond.

However, integration of specialty inputs has not been realized. Specialties have failed to communicate and coordinate with others throughout the design process. This has significantly contributed to the breakdown of systems engineering efficiency.

There is less agreement on a solution to the problems related to improving systems engineering practice. Recommended solutions come in all flavors, highly dependent on the specialty or cause being championed. Some solutions offered include Willoughby Templates for transitioning to production (1985), Acquisition Streamlining (1986), Total Quality Management (1988), Concurrent Engineering (1988), and Integrated Product Development—an Air Force replacement concept for concurrent engineering (1990).

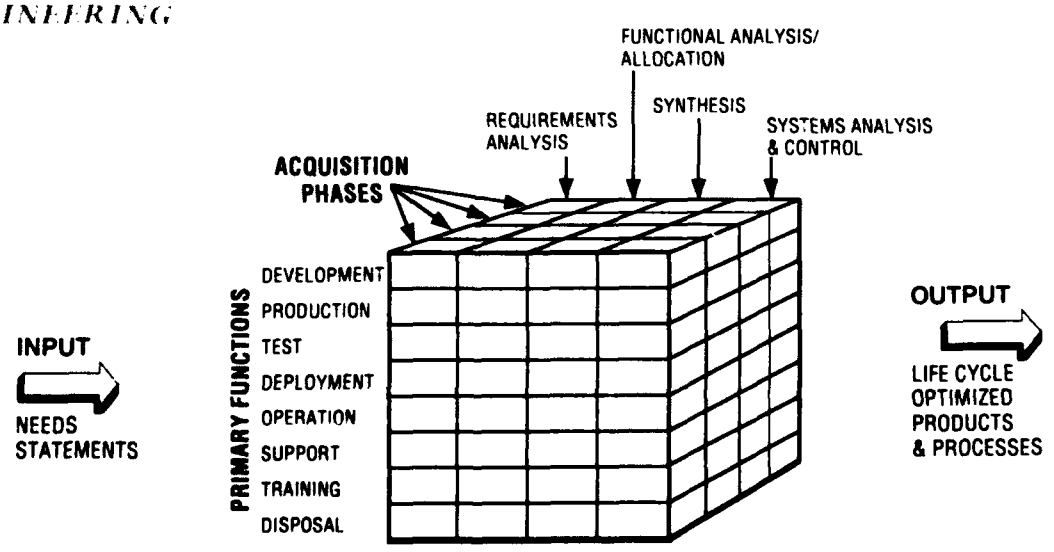
Each solution has its merit. Concurrent engineering seems to incorporate the best in all proffered solutions. Concurrent engineering returns to the basics. It provides a commonsense approach to accomplishing systems engineering—systems engineering as it was originally defined and envisioned (Chase, 1974) before poor specialization integration corrupted it.

Concurrent engineering provides a hope for fixing the shortcomings of systems engineering as practiced. The concurrent design of products and processes can ensure that the systems engineering process is properly accomplished during each phase of the development life cycle (concept definition, demonstration verification, engineering and manufacturing development, production, operations and support). It includes all primary functions for the system and its separate products and processes (developer functions—development, test verification, production and distribution installation; customer functions: operations, support, training and disposal). This framework is illustrated in Figure 1. The commonsense approach of concurrent engineering can provide each user of the system's products and processes with the expected quality, at the expected cost and at the expected time. It has, however, the challenge of acceptance by the varied engineering specialty communities.

Implementing Concurrent Engineering

A necessary (but not sufficient) condition needed to meet the expec-

FIGURE 1. FRAMEWORK FOR APPLICATION OF CONCURRENT ENGINEERING



tations of concurrent engineering is multi-disciplinary design teaming. Design teaming is not explicitly included in the IDA definition but it is in the U.S. Army CED definition and it is also asserted by Chase (1974) as essential for systems engineering effectiveness. Without multidisciplinary design teams working on the various aspects of the iterative systems engineering process, the maladies of systems engineering as practiced will be repeated through the practice of concurrent engineering.

What will it take then to make concurrent engineering succeed? A workshop was held in November 1990 at the Defense Systems Management College, Fort Belvoir, Va., to determine asnwers to this question. The workshop was an initiative of the Office of the Under Secretary of Defense for Acquisition. Six challenges to the implementation of concurrent engineering were examined by 10 work groups. These challenges were products of a 1990 Scientific Advisory Board on concurrent engineering. The challenges were:

- Organizational structures
- Business practices
- Funding and budgeting for concurrent engineering
- Education
- Integration of cost, schedule, performance and risk.

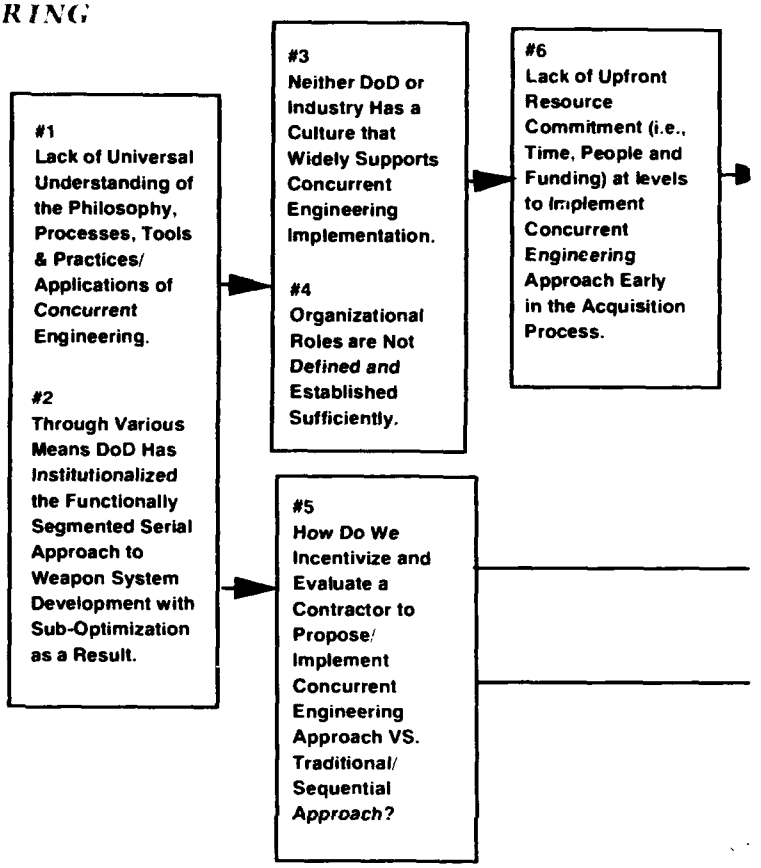
The problems related to implementing concurrent engineering, and peculiar to each of these challenges, were determined at the workshop by 100 representatives from government, industry and academia.

Based on the problems identified by the November workshop, a series of follow-up workshops were scheduled. The goal of these workshops was to develop action plans to help implement concurrent engineering within DOD. The first follow-up workshop was in December 1990. Representatives from each working group participated along with key representatives from the Office of the Secretary of Defense and each Service.

Problems Facing Implementation

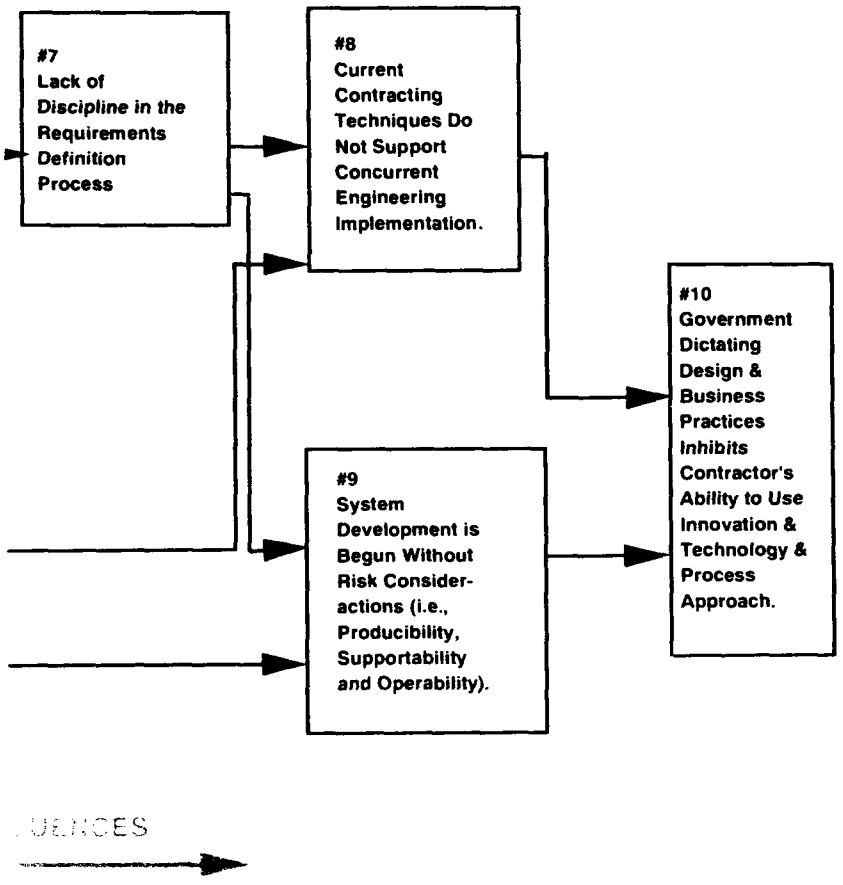
The main product of the December workshop was 10 overall problems related to implementing concurrent engineering. These were distilled from more than 50 problems identified in November. The 10 problems are provided in the influence flow diagram of Figure 2. More than 80 solutions sets were generated for these problems during the December meeting. The second workshop, in late January 1991, generated a more definitized set of solutions and the barriers to implementations of concurrent engineering within the acquisition community.

FIGURE 2. PROBLEMS AND THEIR RELATIONSHIPS IN CONCURRENT ENGINEERING



The interpretation of Figure 2 is that the problems on the left, if not solved, will adversely influence (or aggravate) the problem(s) to the right as indicated by arrows. The rationale for problems #1 and #2 (also problems #3 and #4) being enclosed in the same block is that if one of the problems is solved but not the other, situations will not be improved. It is necessary for both problems to be solved to have a positive influence on the problems to the right. Although several of the problems defined in Figure 2 are specifically stated for DOD, there are direct applications to industry.

Not surprisingly, problem #1 received the most votes in identifying the top 10 problems. Lack of understanding of any process (including systems engineering) significantly impair effective implementation practice of that process. Problem #2 directly addresses the unsuccessful, institutionalized practice of systems engineering. Problems #3 and #4 are directly related to the "stovepipe" organizational structures under which development efforts are being carried out in most U.S. companies and in government program offices.



Problem #6 highlights the lack of sufficient upfront funding to enable early design efforts to include all eight customer and developer functions. Problem #6 also highlights upper management's lack of resolve to truly "fix" acquisition maladies. Requirements instability and incomplete risk assessments (problems #7 & #9) were determined to be pervasive in the practice of systems engineering. Problems #8 & #10 highlight current contracting practice shortcomings.

Thus, for concurrent engineering to be successful and accomplish what systems engineering has not been able to achieve, these problems must be resolved.

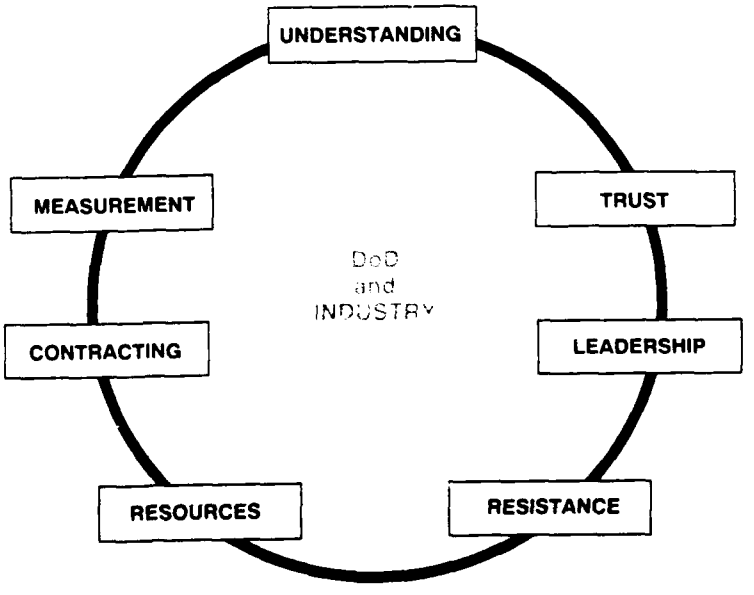
Barriers to Implementation

A set of 63 barriers that would impede application of solution ideas to the 10 problems were identified by the concurrent engineering work group meeting in January 1991. It was concluded that such barriers exist within DOD and industry. To better grasp the significance of these barriers, they were grouped within seven categories—understanding, trust, leadership, resistance, resources, contracting and measurement. The suggested clockwise relationship among these categories is depicted in Figure 3. Strategies for overcoming the barriers related to understanding, resources and contracting can be easily incorporated in implementation actions for the directly related problems from Figure 2.

However, building trust between government acquisition personnel and contractors, finding leaders at all levels of acquisition to espouse concurrent engineering, overcoming "cult" or "stovepipe" organizational resistance, and providing appropriate tools to measure success are more difficult barriers. They must be considered separately in strategies for implementing each solution recommended.

These barriers are further discussed in the "Report on the DOD Workshops on Concurrent Engineering"

FIGURE 3. BARRIERS TO IMPLEMENTING CONCURRENT ENGINEERING



available from the Defense Systems Management College, Director of Publications, RD-P, Fort Belvoir, VA 22060-5426. To overcome the barriers to implementing concurrent engineering, DOD and industry must take aggressive actions, individually and cooperatively.

What First?

Understanding concurrent engineering is not only one of the problems that has the strongest influence on lessening the other nine problems, but is the primary barrier that must be overcome. Thus, solving problem #1 should be given top priority within DOD and its supporting contractors. An explanation of why the problem exists, several imperatives, and the five solutions derived during the concurrent engineering workshops are presented below. These solutions must be collectively implemented to ensure understanding of concurrent engineering by the acquisition community.

Problem #1 exists basically because of a lack of philosophical understanding of integrated approaches to the engineering of manufacturing, test/validation, deployment/installation, operations support, training and disposal to provide optimal products and processes. There are two contributing causes.

First, persons involved with developing systems tend to be specialists who analyze with their left brain, but don't synthesize with their right brain. The systems engineering process requires both analysis and synthesis to be accomplished.

Second, engineers have not been educated to think or act in an interdisciplinary way. Engineering education is traditionally accomplished using a rather strict disciplinary approach. Concurrent engineering, however, requires an interdisciplinary approach. The institutional bias against integrative study and thinking has given us a system of specialists who don't work together as well as could be, who design parts but can't integrate systems.

It is imperative that the DOD and industry work forces understand what concurrent engineering is, how it is accomplished, who is responsible for accomplishing it, and its expectations. It is imperative that a common body of knowledge be established to define what a person must know to be able to accomplish concurrent engineering.

Finally, it is imperative that the relationship between concurrent engineering and systems engineering be clarified. To some people, concurrent engineering means the same as systems engineering, and to some concurrent engineering is done by a program manager rather than by a technical manager under the program manager.

To another group, concurrent engineering is adding support, test and/or production engineering considerations to systems design efforts earlier in the acquisition cycle than presently practiced. The term "system engineering" does not commonly cause folks to think of concurrent engineering, or vice versa.

The Solution Set

The solution set derived at the December workshop to some extent embodies the above imperatives and addresses the contributing causes of the lack of understanding of concurrent engineering by the acquisition community. The five solutions from the January 1991 workshops follow.

—*Top Management Support Concurrent Engineering Education.* Only top management has the means to initiate the changes needed to ensure that the work force is educated in concurrent engineering. Therefore, top management must be convinced that concurrent engineering is a value-added process and that they must make a visible commitment toward education of the work force. Top management support is absolutely essential for meaningful changes in the way systems are developed and produced.

—*Educate the Infrastructure in Concurrent Engineering Education.* Currently, there is broad lack of understanding about the philosophy and practices of concurrent engineering. In order for concurrent engineering to be implemented effectively the DOD and industry infrastructure must be educated in concurrent engineering. Educational and training opportunities must be provided and publicized. Rewards/incentives should be initiated to motivate employees to learn and apply concurrent engineering.

—*Establish Concurrent Engineering Education Opportunities.* Opportunities may be established through any or all of the following.

—**ACADEMIA.** Opportunities for including a systems view and the tenets for concurrent engineering should be sought within established engineering programs. Concurrent engineering principles and philosophies should be integrated into existing curriculums. Courses and areas of concentration should be expanded to inlclude concurrent engineering. Subject specific or "short" courses in concurrent engineering should be used. Research and thesis work in multi-disciplinary topics related to concurrent engineering should be encouraged. Continuing education programs in concurrent engineering should be instituted.

—**GOVERNMENT.** Concurrent engineering should be built into curriculum of DOD/Government schools as part of existing educational or training programs. Universities receiving government-sponsored students should be encouraged to create graduate-level multidisciplinary engineering degree programs and then sponsor students in these programs.

—**INDUSTRY.** In-house training programs should be established in concurrent engineering, specifically in the design process and in multidisciplinary team building. Lessons learned/success stories should be recorded and distributed. Symposiums should be sponsored and attendance encouraged. Consultant provided training should be solicited. Universities that offer programs in multi-disciplinary engineering should be encouraged and supported.

—**PROFESSIONAL ASSOCIATIONS (NCOSE, ASEM, ASEE, IEEE, AIAA).** Concurrent engineering discussions, training, and other activities that will promote concurrent engineering philosophies should be included in annual conferences. Books and journal articles on concur-

rent engineering should be encouraged.

—All constituencies should encourage development of concurrent engineering media (videos, pamphlets).

—*Design Curricula for Concurrent Engineering.* Concurrent engineering topics need to be carefully tailored and integrated into existing systems engineering or engineering management curriculums, in DOD and civilian institutions. Topics should include philosophy, processes, tolls, and applications.

—**PHILOSOPHY.** The product/process life cycle, engineering systems management concerns and a customer orientation should be included in product process design classes. Teamwork, and the important role of people in the product development life cycle, should be emphasized.

—**PROCESSES.** It is essential to include each of the design task processes in a design course, especially the processes for production, test, support and disposal. Competitive design techniques should include design-for-manufacturing (DFM), design-for-assembly (DFA), design for simplicity (DFS), multi-functional teams team building, process measurement and control, variability reduction, and benchmarking.

—**TOOLS.** Curricula should include the following specialized tools: quality function deployment (QFD), design of experiments, statistical process control (SPC), CAD CAM CAE CIM, Ishikawa (cause-effect fishbone) diagrams, Taguchi methods, computer aided system engineering, common design data base, computer aided software development (CASE), and computer aided logistics support (CALS).

—**APPLICATIONS.** Case studies (industry success stories) should be generated by industry, academia and DOD institutions and integrated into appropriate courses.

The degrees of emphasis in a program or short course of the above four areas are in Figure 4 for the three major levels of organizations:

—*Dialogue Within and Among Constituencies on Concurrent Engineering.* Concurrent engineering or systems engineering does not suffer from lack of attention by various interest groups. However, there is little to no dialogue between groups. The approaches advocated are often conflicting or at least in differing directions.

There is little or no dialogue between interest groups . . . approaches advocated are often conflicting or at least in differing directions.

For example: One of the first sponsors of concurrent engineering was the Society for Manufacturing Engineers (SME). Their journals have generated the most articles on this topic. The SME, in cooperation with the University of Southern California and Digital Equipment Corporation, sponsored a 3-day conference, "Managing Concurrent Engineering: A Full Spectrum Approach." This conference had a business focus with emphasis on automation in manufacturing.

Additionally, CALS oriented logisticians have expressed an interest in concurrent engineering. This interest appears to be motivated by using concurrent engineering as the basis for implementing CALS.

The ORSA/TIMS generally takes a more operations research approach to systems engineering. The ORSA journal tends to publish more mathematical, academic articles. This is due to the fact that many systems engineering programs have an analytical/OR base.

The American Society for Engineering Management's journal has not focused on systems engineering. Since it does focus on managing engineers and technology, articles discussing concurrent engineering would be an excellent addition.

The National Council on Systems Engineering was organized in August 1990 to address systems engineering matters. The issues facing systems engineering—its lack of recognition and effectiveness—are major topics being explored by the council. In a paper presented to the council, the concept of concurrent engineering was not readily accepted. The various society association interests tend to be parochial in that their thrust is to gain proper recognition in the design development process for their discipline, rather than the more global goal embodied in the underlying principles of concurrent engineering.

Other activities advancing concurrent engineering include: IEEE is writing an industry standard on systems engineering which is intended to embody the concepts of concurrent engineering. The committee includes industry representatives

FIGURE 4. MAJOR ORGANIZATION LEVELS

	PHILOSOPHY			
	PRINCIPLES	PROCESS	TOOLS	APPLICATION
TOP MANAGEMENT	X	O	O	O
ENGINEERING MANAGERS (MID-LEVEL)	●	X	X	X
ENGINEERS	●	●	●	●

LEGEND: ● WORKING KNOWLEDGE X UNDERSTANDING O AWARENESS

and the Defense Systems Management College. In addition, the EIA NSIA AIA IEEE, NCOSE, and ASEM are actively involved as reviewers of the pre-coordination draft of MIL-STD-499B for systems engineering. It is intended that MIL-STD-499B implement concurrent engineering within the defense community.

There are several approaches to establishing better dialogue. Five follow.

—DOD should sponsor joint symposiums and forums. Specific audiences should be targeted and information distributed to gain widest attention within the acquisition community and academia.

—Defense agencies should sponsor joint conferences to discuss concurrent engineering. The U.S. Army Materiel Command is sponsoring meetings in the headquarters to discuss concurrent engineering implementation issues. In addition, joint meetings are scheduled at the major commands to discuss implementation issues. I have been invited to address a joint group to discuss concurrent engineering concerns, and also chaired a workshop on concurrent engineering at the July 1991 Defense Systems Management College Alumni Association Symposium.

—A clearing house on concurrent engineering should be established to collect and distribute lessons learned and provide information on "best practices." This could include managing a data base for electronic dissemination of information and a hot line.

—Encourage exchange opportunities among industry, academia, and defense educational units.

—Publication and distribution of papers related to concurrent engineering should be included in all engineering journals. Papers should be targeted to different levels of management and practice.

What Must Be Done Next?

According to the technique used to construct Figure 2, the next priority solution set to implement is associated with problem #2, overcoming the institutionalized, functionally segmented serial approach to weapon system development. Also based on the theory behind Figure 2, the implementation of solutions associated with problem #2 is a must in order for solutions to problem #1 to be effective. Ten solutions were recommended by the concurrent engineering workgroup for problem #2. Implementation of these solutions has been initiated with the publication of the 5000 series of DOD guidelines. Acceptance and implementation of draft MIL-STD-499B distributed in May 1992, and its planned handbook in 1992, will complete actions on the solutions recommended.

The 5000 series reflects concurrent engineering principles as reflected in this article and the concurrent engineering workshop report.

The draft 499B calls for the creation of program office teams (contractor and government) that will minimize functional organization, encourage a system approach to program management using concurrent engineering techniques, and create multidisciplined government contractor interfaces. In addition, implementation of 499B will provide an integrated program review process; structure the RFP to integrate the systems engineering effort; place equal emphasis of product and process throughout development; and require each stage of development to demonstrate not only performance but also producibility, testability and supportability.

A handbook planned on systems engineering will provide nonmandatory guidelines for implementation of concurrent engineering principles.

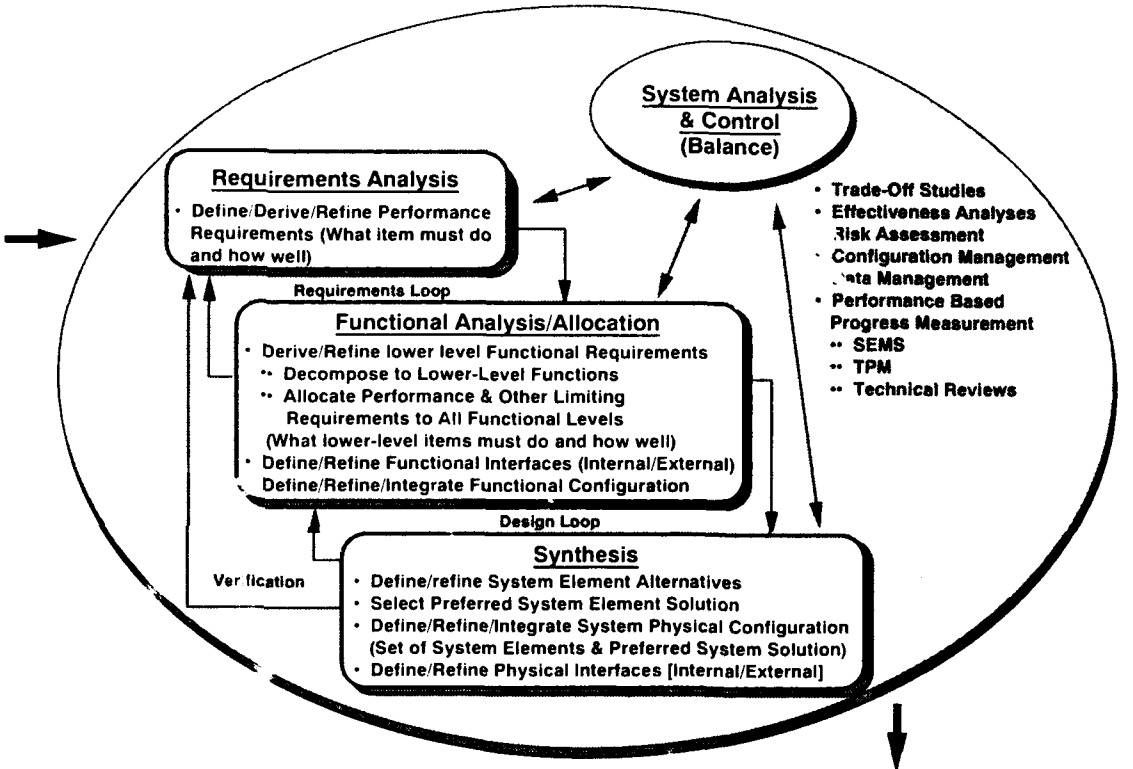
In conjunction with resolution of problems #1 and #2, the draft 499B will implement recommended actions to solve the remaining eight problems. Establishment of multidisciplinary design teams and functional review teams will help change DOD and industry cultures, and define and establish organizational roles in carrying out efficient and effective systems engineering as envisioned (concurrent engineering).

The contractor will be incentivized to implement concurrent engineering by requirement to submit with each proposal a systems engineering management plan (SEMP) to describe how systems engineering will be accomplished in accordance with 499B and in response to the RFP. The negotiated SEMP will be the basis for contractual work in lieu of the standard. The SEMP will contain plans for technical control, systems analysis, technology transition, integration of technical inputs and the various specialties, and technical reviews (problems #5, #8 and #10).

The draft standard requires accomplishment of the systems engineering process elements (see Figure 5) during each phase of the program. This process requires revisiting requirements (problem #7) and considering all sources of risk for each of the eight primary functions (problem #9). By applying the systems engineering process to each of the primary functions during early phases of the program, the contractor's proposal will include resource requirements (time, people and funding) necessary to conduct a concurrent engineering approach. This will result in clarification of downstream functions in upfront activities. Thus, implementation of 499B will build in the definition of and need for upfront resource commitments (problem #6)

(Continued on inside back cover)

The views expressed in this article are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.



LEGEND

User = Developer & Customer

User Primary Functions = Development, Production, Test/Verification, Deployment/Installation, Operations, Support, Training, Disposal

System Elements = Hardware, Software, Personnel, Facilities, Data, Material, Services, Techniques

Item = System, Segment, Configuration Item, Set of Configuration Items, or System Element

THE ROLE OF DSMC IN SOFTWARE ACQUISITION

Change at College

Sherwin J. Jacobson
James H. Dobbins

The education of program managers, conducting research in acquisition related topics, and providing consultant services to the Department of Defense are the primary missions of the Defense Systems Management College (DSMC). To accomplish these goals effectively, the entire educational program has been restructured around the new DoD 5000 series of directives and instructions. In the software management department, the primary emphasis is now on integration of software into the total systems development effort. Every program manager must understand that if software is ignored, it will most likely be a primary factor in the failure to deliver an operational system.

The challenges faced by the software management faculty at DSMC are to incorporate the management guidelines of DoDI 5000.2 into the software curriculum, and to apply these guidelines in the research and consulting services offered by DSMC. These three activities have one central objective: to do what we can to make the program managers self-sufficient in dealing with software issues. These challenges must be met for students and consulting customers who have a wide range of backgrounds, without trying to make them software experts. It requires that the students and other customers understand the nature and issues related to software development management, and the related risk issues. How much the students must learn about software development itself to manage the development process effectively is a question we never stop asking ourselves. It is our biggest challenge.

The DSMC stands willing and able to provide expert consultant and research services to OSD and the acquisition community in the Department of Defense on an as-available basis.

Consultant and Research Services

To help us expand our capabilities, and increase our effectiveness, the software management faculty at DSMC currently provides consultant and research services to all of the Department of Defense. To date, we have helped the Services develop RFPs, choose source selection techniques, choose and apply metrics, develop management structures and strategies to reduce and overcome risk, provide information on how to conduct design reviews, review IV&V contracts, and look at software testing issues. We have provided consultant services to the Office of the Secretary of Defense (OSD) through the review of policies and directives, assisting in the development of new standards, and served on teams producing various OSD level plans and documents.

The DSMC has also researched and published the *Mission Critical Computer Resources Management Guide*. Other research has been conducted in the areas of risk management, acquisition strategies for software, and critical success factors. The DSMC currently serves on the advisory board of the Software Engineering Institute's (SEI) Process Program.

In restructuring our classes for the Program Management Course using the new DoDI 5000.2 as the outline, we cover such subjects as the Computer Resources Life Cycle Management Program (CRLCMP), Ada issues, Software and the Systems Life Cycle, Design Reviews and DoD-STD-2167A, Risk Management and Acquisition Strategies to reduce risk, contracting for software, source selection, management and quality metrics, test and evaluation of software, and software from the contractors perspective.

Both authors serve at the Defense Systems Management College. Mr. Jacobson is the Software Department Chair and Mr. Dobbins is a Professor of Systems Acquisition Management.

Helping Each Other Most Effectively

Although we constantly try to improve this curriculum, the next step in our efforts is to have the acquisition community review our work and make recommendations on software acquisition issues which need to be added or deleted from our current curriculum. Accordingly, so we can help each other most effectively, we are asking that those who are practicing program managers, or are on program office staffs, provide us with information on the most pressing issues affecting their performance in managing software intensive programs. The way DSMC can be most effective is to understand and address these issues. We need to help each other, and in so doing can build the most effective possible acquisition community.

The DSMC stands willing and able to provide expert consultant and research services to OSD and the acquisition community in the Department of Defense on an as-available basis. For information concerning these services or to provide inputs into our efforts to improve the software management curriculum at DSMC, please contact Mr. Sherwin Jacobson at (703) 664-3597 or DSN 354-3597.

EXPERIENCING DIVERSITY

(Continued from page 9)

cluding others, advertently or inadvertently.

Managers must personally value diversity in the work force. As leaders of work teams, managers need to ensure that work groups or organizations recognize contributions of a diverse group. There are numerous things the group can do.

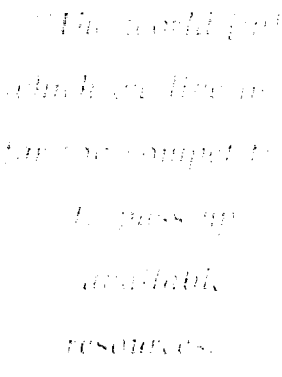
Breaking Barriers

Gathering data by using an organizational climate survey can establish a baseline for perceptions of the group organization. Awareness training for everyone in the organization can instigate dialogue on diversity. The video used in the workshop, "Managing Differences," by Copeland-Griggs, is one of many focusing on increasing productivity by valuing participation.

Process action teams (PATs) can help a group develop ideas for breaking organizational barriers. Celebrations of cultural contributions by various groups through programs and activities are successful ways to acknowledge differences in many organizations. Support groups for networking and developing formal mentorship programs have shown success in some organizations.

Jack MacAllister, Chief Executive Officer of US West, said in the *Junior League Review*:

> The world which we live in is far too competitive to pass up available resources. You'll not win races for long, firing only half of the cylinders in your engine....In my opinion the only way to be competitive is to use all of the talent you can muster, no matter how it is packaged. (1987.)



The bottom line in looking at the work force in the year 2000 and beyond is that it will be different in terms of demographics and values. To capitalize on all talent and potential within the work force, program managers in the acquisition corps and supervisors throughout the government need to be more aware of their frames of reference for dealing with "otherness." They must learn what motivates team members who are different in their dimensions.

Managers need to develop opportunities for people who are "different" to excel, so that everyone feels valued and appreciated as contributors to the work/mission. By accepting "different as different" instead of "different as deficit," the program manager can create a work environment capitalizing on strengths of every team member and give each an opportunity to maximize potentials.

By understanding and valuing diversity, the program manager can manage the diverse work team more effectively.

References

Edwards, A. (1991) "The Enlightened Manager," *Working Woman*, January, pp. 45-51.

Fortune, "How America Will Change Over The Next 30 Years," June 17, 1991.

Geber, B. (1990), "Managing Diversity," *Training*, July, pp. 23-30.

Johnston, W. (1987), *Workforce 2000*, Indianapolis, Hudson Institute.

Johnston, W. (1989), *Civil Service 2000*, Indianapolis, Hudson Institute.

Junior League Review (1987), "The Necessity of Diversity," Spring, pp. 8-10.

Kanter, R. M. (1977), *Men and Women of the Organization*, New York, Basic Books.

Rosener, J. and Loden, M. (1991), *Workforce America!*

Smith, Perry (1990), "Be a Better Leader," *Army Times*, December, pp. 41-46-50.

Thomas, R.R. (1990), "From Affirmative Action to Affirming Diversity," *Harvard Business Review*, March-April; pp. 107-117.

IMPROVING THE ACQUISITION WORK FORCE

"An IDEA Whose Time Has Come"

Major Robert L. Landry, USAF
Captain Gregory A Garrett, USAF, CPCM

In the complex world of defense acquisition management, understanding government and industry perspectives is of great value. Ultimately, such insight improves the acquisition work force for both, and for taxpayers. Many Air Force personnel, military and civilian, have had the opportunity to gain this "dual vision" in the last 44 years through the Air Force Education With Industry (EWI) program.

This program is managed by the Air Force Institute of Technology which provides selected Air Force personnel an opportunity to experience, up close and personally, the rewards and pitfalls of a defense contractor in an era of declining budgets and layoffs. It's an eye-opening experience.

With the success of *Desert Storm* and renewed interest in and respect for U.S. military capability, this program should become more valuable for the "smaller, smarter" Air Force of tomorrow. As we try to "do more with less," it is important to foster true teamwork among Department of Defense acquisition agencies and industry counterparts. This program is catching on.

Years ago, the Army started its version of this program, the "Training With Industry" program. The Navy followed with the Experience With Industry program. Recently, we were contacted by NASA to help start its EWI-type program. *This appears to be an IDEA whose time has come.*

The acronym IDEA means Industrial Development Education in Acquisition, an outgrowth of the original EWI program. The Air Force Institute of Technology developed IDEA for Air Force acquisition personnel as a result of defense management review (DMR) reforms that the Department of Defense has been, and is, undergoing.

During the DMR and other acquisition work force studies, investigators recognized the DOD acquisition work force knew little about defense industries, in general, like mindsets, frustrations, profit/loss bottom lines, organizational constraints, etc. This resulted in suggestions for a "walk-a-mile-in-my-shoes" type program.

Improve Professionalism

When the Congress implemented the Acquisition Workforce Improvement Act of 1990 to improve professionalism of government acquisition personnel, a high-level Pentagon working group was established to improve quality of the Air Force acquisition work force. This group manages implementation of new professional development programs for the Air Force. Comprising general officers up to the three-star level and civilian equivalents, it is called the Acquisition Professional Development Council (APDC). In April 1990, it acted on the DMR investigators' suggestions and directed AFIT to develop a *mini-EWI* program of short duration.

The Air Force Institute of Technology developed the IDEA program architecture and theory based upon lessons learned from the EWI program. The APDC approved it in August 1990 and AFIT was host to a customer working group conference in September 1990 to discuss with our customers specifics like program mechanics, policies and selection of students. The conference included acquisition policymakers from the Air Force, former EWI students, and company representatives from the current EWI program. The customer working group and AFIT developed the IDEA program as an advanced and condensed EWI program for experienced Air Force acquisition personnel, military and civilians.

Major Landry is the IDEA and EWI programs manager, Air Force Institute of Technology, Wright-Patterson AFB, Ohio. He is a 1985 EWI graduate with McDonnell Douglas.

Captain Garrett, CPCM, is assistant professor of contracting management, Air Force Institute of Technology. He is a 1986 EWI graduate with Northrop Corporation.

The National Management Association, publisher, grants **Program Manager** *permission to reprint this article from the June 1991 issue of its* **Contract Management** *magazine.*

Understanding Industry

To understand how the IDEA program works, it is important to know the background/operation of the EWI program today. In 1947, General Hap Arnold determined that the Air Force made too many acquisition mistakes during World War II. To rectify the situation, he sent several colonels to industries to work at top-management levels and understand industry better. He hoped the colonels would learn from past mistakes and return to the Air Force to revamp policies and procedures. General Arnold's program has continued—with many changes during the years.

The EWI program today is used primarily to cross-train selected military officers in the contracting and manufacturing career fields. Today, the majority of these military EWI students come from non-acquisition positions; i.e., missiles and administration. Having little defense acquisition knowledge, they attend either a 5-week systems contracting course in Denver or a 2-week manufacturing course in Dayton before beginning a 10-month internship, starting each September, at companies like Boeing, General Dynamics and McDonnell Douglas. More than 100 companies participated in the EWI program in the last 4 decades. The top 11 companies (in terms of years participating in EWI) are as follows: Boeing, 44; General Dynamics, 41; McDonnell Douglas, 41; Northrop, 41; Hughes, 36; Aerojet, 35; General Electric, 35; Lockheed, 34; Westinghouse, 34; Kodak, 32; and Textron (AVCO) 32.

When students complete the EWI program, they generally are assigned to an acquisition command, usually in a system program office, acquiring new weapon systems, or in an Air Logistics Center, managing existing systems, spares acquisition, etc. For a detailed look at the EWI program, read "Education With Industry in Contracting Management—An Officer's Perspective" by Captain Gregory A. Garrett, in the July 1987 *Contract Management*. The new IDEA program is similar to the EWI program but incorporates key differences.

After World War II, General Hap Arnold sent colonels to industries to learn, then return to the Air Force to revamp policies and procedures.

IDEA Program Features

Program Length. Unlike the 10-month EWI program, IDEA is constricted by time, with a maximum length of 6 months. Most programs last approximately 5-5½ months. This necessitates getting twice as much done in half the time. While all EWI students have an orientation period, the IDEA student is limited to a tight orientation schedule of 5 days or less.

Highly Experienced Students. Unlike EWI, this program selects only experienced captains, majors, lieutenant colonels and GS/GM-11s through 14s. They meet high standards of education and acquisition experience, are fully qualified in one or more functional areas, and specialize in a narrowly focused, shortened program.

Functional Program Focus. Although our Air Force customers allow these students to experience an overview of various functions within the company, the IDEA program focus is tailored to specific student functional expertise and company requirements. A no-cost service contract is endorsed by both parties to specify what is required in each case. The program's goal is to focus on a single short-term project with results that can be measured in terms of a final product.

IDEA Papers. While all EWI students must submit a standard report outlining their observations, activities and suggestions for government process improvements, the IDEA student has a special document to produce. This includes being the author of a 10-page (minimum) manuscript on a specific topic in their area of expertise, or an article summarizing ideas for improving government or industry processes, based on work with industry. All manuscripts will be placed into a program compendium and reviewed by an AFIT editorial advisory board for potential publication in professional magazines or journals.

As you see, this is a focused program where experienced students will need a demanding program for a shorter time. It started with 29 military and civilian students on 29 April 1991 and will end 27 September 1991. Thirteen contractors are involved in this program. A follow-up review will occur and the APDC will make needed changes.

During this trial effort, to keep costs at a minimum, students are selected from, and limited to, Boston, St. Louis, Los Angeles and Dayton. Students negotiate with AFIT and a potential company for specific job direction before entering the program, which requires insight, coordination and flexibility among the three parties. We are confident their efforts will be worthwhile and provide the desired environment for a stronger team relationship, with less animosity. It's a "win-win" situation.

—It's a win for the company of "free" expert labor
—It's a win for the student of increased knowledge and understanding industry
—It's a win for the Air Force of better qualified acquisition personnel.

We continue to look for companies to be hosts to future IDEA students in these options: acquisition logistics, engineering, contracting management, program management, comptroller, science and technology, test and evaluation, and manufacturing communications-computers.

For more information, write to Major Robert Landry, AFIT/CISH, Wright-Patterson AFB, Ohio, 45433-6583.

COST/SCHEDULE CONTROL SYSTEMS CRITERIA

It May Be More Than We Think

Irwin J. Faibisch

The preface of the *Cost Schedule Control System Criteria (C/SCSC) Joint Implementation Guide* contains a white paper defining objectives of C/SCSC. They are:

—For contractors to use effective internal cost and schedule management control systems

—For the government to be able to rely on timely and auditable data produced by those systems for determining product-oriented contract status.

Once upon a time in the history of C/SCSC, we heard "Cost Schedule," and "Technical Performance" defining its value. The Technical Performance aspect seems to have evolved away from current mainstream usage; it has nearly disappeared from C/SCSC lexicon and that is a loss to the practice of program management.

The thesis of my article is that technical performance is an inherent part of the C/SCSC; a metric that has fallen into disuse and ought to be revived. Technical performance is at the core of the C/SCSC; properly as an enabler, a vehicle of action, within. Use of technical performance as a metric is key to achieving effective and efficient program manage-

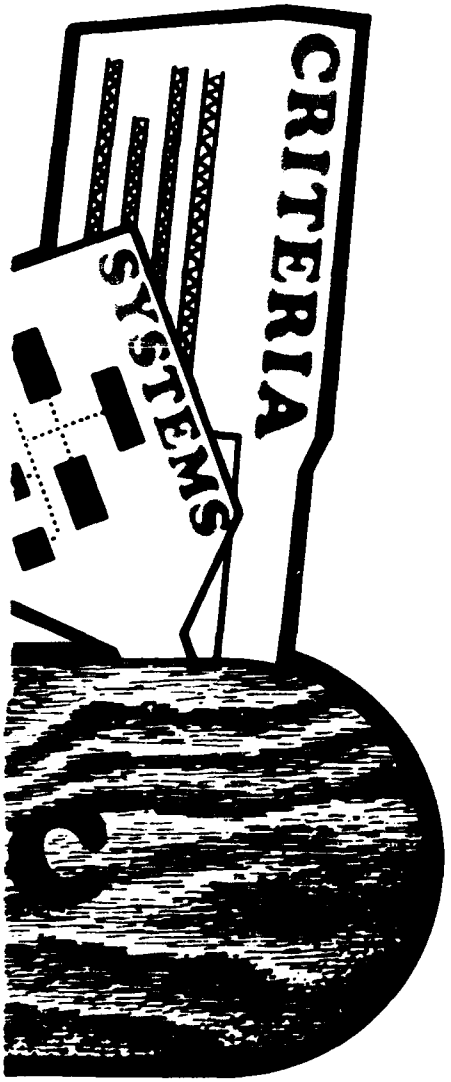
Mr. Faibisch is chief of contractor program management and focal point for Cost/Schedule Control Systems Criteria at the National Security Agency, Fort Meade, Maryland.

ment. To focus on this aspect of the C/SCSC and facilitate its return to general usage, the white paper's first objective might better read:

> —For contractors to use effective internal cost, schedule and technical management control systems....

Perhaps there would then be a stronger incentive for users and beneficiaries of C/SCSC to take better advantage of its built-in framework for the real-time technical performance. They are, if not the same thing, inextricably comingled.

What does C/SCSC provide that makes it, or should make it, the basis of competent program management? Most prominent aspects of the C/SCSC are:



—Provide a time-phased program management baseline that integrates the work to be accomplished with its schedule hierarchy and the budget established to accomplish the work

—Provide a systematic parsing of the work into manageable, visible and hierarchal "chunks" according to an established product-oriented work breakdown structure

—Provide cost accounts and their derivative work packages that define fields upon which cost and schedule parameters, and technical descriptions of the "chunks" of work are required to be accomplished. Cost accounts and work packages provide visibility and details of what should be going on within the contracts, and what actually is going on. The cost account, by whatever form, provides the medium—an arena—upon which the need for corrective action is identified and action is taken.

TQM & C/SCSC

The Joint DOD Industry Total Quality Management Team Report for Program Mangagement on the Cost Shedule Management Process, published May 17, 1991, helps us take a fresh look at old habits. It gives 18 recommendations to improve the C/SCSC process, of which 10 relate directly to Cost Performance and Cost Schedule Status Reports generated by contractors' management control systems. Five relate to baseline planning, and one each to training and administration. The other encourages groups like the National Security Industrial Association and the Performance Management Association to continue improving cost schedule management methods, practicing and reporting. It addresses management methods, presumably including *technical management* which it shares with *reporting*.

This reflects views and priorities of the sampling of government and industry C/SCSC customers interviewed by the C/SCSC TQM Process Action Team. It is a reasonably accurate assessment of prevailing views of the C/SCSC community. It demonstrates that people using and benefitting from the C/SCSC value and rely upon reporting that C/SCSC enables; and, not much on the inherent value of C/SCSC as a facilitator of actual day-to-day management of contracts.

Total Quality Management implies that the "customer is king." What if the customer (individual or collective) is narrowly focused or unfamiliar with some aspects of C/SCSC discipline and is, therefore, unaware of the value existence of all technical tools available within the C/SCSC? In these circumstances, TQM probably will facilitate only processes known and understood and, thus, are viewed as valuable, or useful, by the practitioner customers. It won't open customers' eyes to all opportunities, had they been introduced, made known and explained. The result: TQM will improve recognized and familiar (albeit imperfect) processes, but will not broaden processes outside established boundaries until those boundaries are expanded in subsequent efforts.

If the program manager's world is defined in terms of the Cost Performance Report (CPR) or the Cost Schedule Status Report (C/SSR), or contractor internal equivalents (instead of the process of and the utility of the contractor's management control system), resulting improvements should be mostly in the reporting area. The proactive management control process would continue at low ebb—business as usual.

The TQM team reports that "Conclusions clearly indicate that both DOD and industry place high importance on the need for cost schedule management control systems." The principal C/SCSC customer is generally recognized as the program manager, whether employed by government or contractor. Program managers and those with like responsibilities often extol C/SCSC virtues in terms of internal and external reports that management control systems generate. They regard these reports as useful tools for *managing* the contract. These managers seem to put the true management tool inherent in C/SCSC into the background. They focus instead on internal and external *reporting* aspects of C/SCSC, and then use reported information for reactive *management* purposes.

The major contribution of C/SCSC should be in the proactive utilization of its disciplines at the point where management control is, or should be, imposed—within the cost account. Reports come later and present a summarized history of activity to date. When used correctly, C/SCSC provides the program manager and cost account manager the opportunity and means to take appropriate action at the most opportune time— as problems occur. That is when problems are amenable to efficient resolution.

Using the contractor's C/SCSC compliant management control system merely as a *de facto* provider of internal or external reports is a self-imposed limitation on the primary purpose of the C/SCSC; that is, to provide a means of control and management of the program or project. The C/SCSC is capable of broader contributions to program management than providing information after the fact. It is more than a mechanism for providing cost and schedule discipline and visibility; however, that is what many otherwise knowledgeable users and some C/SCSC *"cultists"*[1] believe and practice.

The C/SCSC influence on effective program management ought to be focused on physically carrying out the baseline plan, not merely telling where to be in terms of scheduled vs. earned vs. costs. This unfortunate turn of events (program manager and cost account managers who generate and in turn rely on reports, rather than on contemporary hands-on indicators within the contractor's management control systems to facilitate action) may reflect job descriptions of C/SCSC practitioners, many of whom are budget or fiscally oriented program control people.

Doesn't it make more sense for program management at the cost-account level, utilizing C/SCSC as its principal vehicle, to be handled by engineers and technicians, usually the people physically responsible for producing the product? These people need to be educated to take full advantage of C/SCSC technical management power. Unfortunately, these are the people frequently viewing C/SCSC as an onerous burden, useful for producing after-the-fact cost and progress reports. If so, can you blame them for focusing on reports rather than action?

The inevitable conclusion is that work packages and cost accounts are the principal places where technical performance should be assessed and where corrective action should be taken (along with budgets, schedule, value earned, actuals consumed and the related indices, variances, and forecasts).

Most experienced program project managers and bosses advise that no person can be all things for all program-management purposes. It is recognized that program managers cannot solely be competent in all technical disciplines of a decent-sized program, and possess the interpersonal, fiscal, motivational, and organizational skills to do the job competently.

The program manager's primary responsibility is to get the job done by whatever legal means is necessary. Since no one can have technical knowledge in all fields of a complex program, the program manager delegates detailed technical and cost and schedule management reqirements to lower-level managers—the cost account managers (CAMs).

Cost Accounts Cost Account Managers

The title cost account manager implies that cost is the primary driver, which it is not and shouldn't be. Cost management and cost control are important but CAMs must be more than cost sensitive. They are charged with the same requirements as the program manager—but the CAM program is their responsibility. The cost account manager is responsible for getting the job done within cost, on schedule, technically acceptable and complete. The CAM job description has many requirements like that of the functional boss—limited, however, to tasks for which the CAM is responsible.

Perhaps we should consider replacing the term cost account with a more descriptive term. Since the CAM is responsible for more than costs associated with his work, a better term might be management account or work account. Or let's consider eliminating "account," which recognizes only cost money aspects.

Functional task is suggested as an improvement of the present cost account,[2] and the cost account manager would become the functional task manager. These suggestions may be difficult to initiate but should be given serious consideration by, among others, the Performance Measurement Joint Executive Group National Security Industrial Association.

One favorite expression in the community is that it is "just one of many tools in the kit of the program manager." That's true, but is an oversimplification. It is a manifestation of a too-narrow interpretation of the role and value of C/SCSC, which should be the principal tool of program managers and sub-managers to perform their respective jobs.

Other tools which could be used in other closely related disciplines—such as addressing the funding problem through the Contract Funds Status Report (CFSR) or as a supporting tool for the program manager's primary job of delivering a product—contribute to fulfilling requirements of the program manager. These tools should not be primary mechanisms directed to delivering a competent product on schedule and within established cost limitations.

Government and contractor program managers should use mechanisms established by C/SCSC as principal vehicles for managing the program; that is, as integrator of other management tools, specifically including management of technical performance. Other disciplines like scheduling methodolgies feed into and support the C/SCSC, and provide their qualities to benefit their disciplines. An example is scheduling disciplines to address the scheduling problem, while providing the basis for scheduling the C/SCSC baseline plan.

Conclusions

Program managers, cost account managers or functional task managers, program control people and others using, generating or depending on the management con-

trol system defined by the C/SCSC should not think that C/SCSC owes its value and existence mainly to the CPR and C/SCSC (and internal equivalent) reports it supports.

Because C SCSC provides an ethical and disciplined mechanism for the management of a program by providing the framework for planning, controlling and progressing, C SCSC's principal value lies in its program control and planning attributes. This is an independent function of C SCSC and does not detract from its role in generating management reports that are useful as cost indicators and, because they are inexorably tied together, as technical-accomplishment indicators.

The foregoing is not meant to lessen the value of internal or external management reports; they are the eyes and ears on the program. But, they are after-the-fact reports telling us where we've been and where we expect to go.

Program managers and their peers and overseers must become comfortable with the concept of using the C SCSC internally, in real-time, to assess the condition of the program or its subsets; and, to use the C SCSC as the field of action determining and doing what needs to be done.

Contractors' internal management control system structures provide the instantaneous detailed performance measurement visibility that tells us what's happening now.

That's where the action is.

Endnotes

1. The term "cultist" is not meant as a derogatory or pejorative reference, although it sometimes is used that way. By cultist, I mean anyone who is or is perceived as an expert imbued in C SCSC disciplines.

2. Thanks to Doug Fisher, Superconducting Super Collider Laboratory, for suggesting this term.

WHY LEADERS CAN'T LEAD

(Continued from page 17)

clever and ambitious but with no real understanding or vision.

Part Four: Parts of Solution

—Institutions and organizations are designed to make society, not the individual, prosper.

—As the leader learns to fulfill his or her own vision, it is part of the leader's job to assist employees to fulfill their visions.

—Too many executives prefer to deal with simple day-to-day problems and settle for small wins, rather than deal with the over-reaching problems.

—Too many people seek and accept simplistic solutions for complex problems and never question the solutions.

—Our collective incapacity to tolerate ambiguity in the face of enormously complicated problems has led us to an almost automatic acceptance of instant relief.

—Americans seem unwilling to use their best qualities—integrity, dedication, magnamity, humility, openness and creativity—the basic ingredients of leadership.

—Anyone who intends to lead us out of the current slough will have to exercise vision and virtue.

—One thing an executive needs above all is truth, all of it, all the time, and it is the one thing the executive is least likely to get from his assistants, if they are cut from the same cloth. Therefore, executives have to surround themselves with people who can recognize the truth when they see it, and convey it to the executive whether he/she wants to hear it or not.

—Leadership is as much an art as a science.

—It is the true leader's task to create not only the climate of ethical probity, but a climate that encourages people to learn and grow.

—People in positions of authority must be alert, curious, impatient, brave, steadfast, truthful and in focus. These people must develop the vision and authority to call the shots. They must have entrepreneurial vision, a sense of perspective, and be able to identify the forces at work on both specific organization and society in general.

—Leadership is more practice than theory and is practiced in the real world, not a laboratory.

—Leaders do not avoid, repress, or deny conflict, but see it as an opportunity.

This book explains how leaders can lead. It offers penetrating advice to leaders on how to take charge, and how to deal with troublesome issues.

Mr. Bennis hopes he can look back 12 years after he wrote the book and muse, "Where have all the leaders come from?" Perhaps consideration of the ideas Mr. Bennis presents in this book will help bring about changes needed and provide the answer.

A NOBEL PRIZE WINNER

SIMON SAYS

Rational Decision-making for Source Selection

Lieutenant Colonel Vernon E. Francis
Captain Christopher M. Antons
Captain Jeffrey S. Stonebraker

Source selection is a crucial stage of the systems acquisition process. It is a decision to which much time, effort, thought and resources are devoted. This decision process, *studied* and *analyzed* during the years, (resulted) in Federal Acquisition Regulations (FARs), Department of Defense directives, regulations and policies of all Services and specified commands. These directives, regulations and policies create a framework for selecting the best source selection decisions of considerable complexity, involving much money and affecting the ultimate structure and readiness of U.S. forces. The importance of careful, thorough decision-making is summarized in the Federal Acquisition Regulations. Source selection procedures are designed to:

> Maximize competition; minimize complexity of the solicitation, evaluation, and selection decision; ensure impartial and comprehensive evaluation of contractors' proposals; ensure

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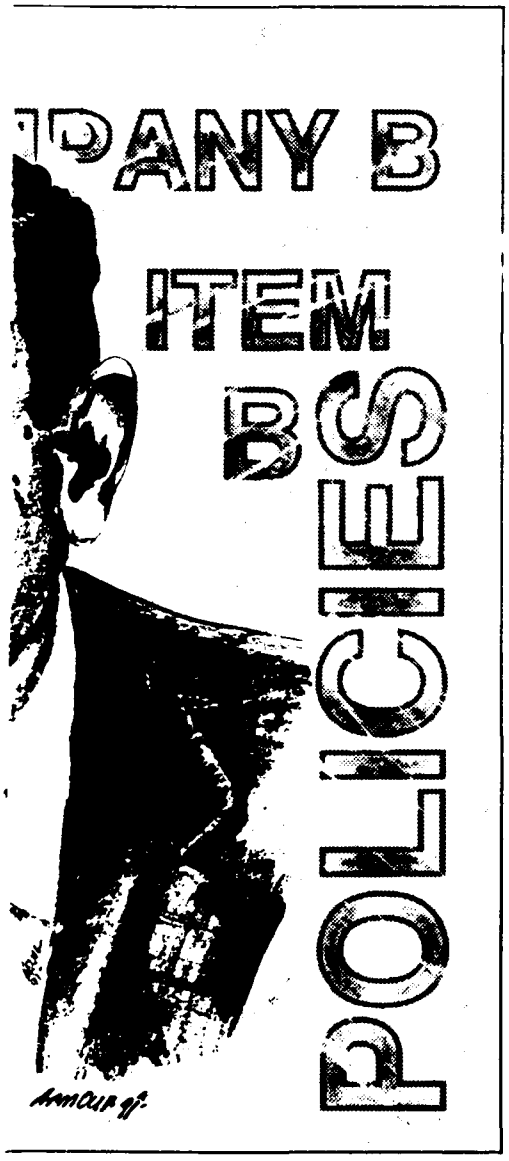
All are active in the Academy Acquisition Research Group, sponsored by the Defense Systems Management College, which also sponsored this research.

selection of the source whose proposal has the highest degree of realism and whose performance is expected to meet stated government requirements best.

Individual Services specify similar objectives in source selection regulations.

Of central importance to source selection, when viewed as a decision process, are these issues.

—What constitutes the best decision? More fundamentally, how do we recognize good decision-making when we see it?



—Does the current framework for source selection, as contained in current regulations, directives and policies, promote good decision-making?

—Can people learn to become good decision-makers? Can decision-making skills, particularly in the realm of source selection, be improved?

This paper focuses on the first question. We will describe one concept of good decision-making. In particular, we summarize Herbert Simon's work on rationality, which spans more than 40 years of studying decision-making in organizations, work for which he received the Nobel Prize in 1978.

In another paper, we will summarize empirical evidence gathered by leading decision theorists and cognitive psychologists during the last 30 years, regarding how people make decisions in organizations. This paper directly addresses the question: Do people inherently make good decisions? Deficiencies, biases and inconsistencies that appear with disturbing regularity will be discussed and illustrated. In yet another paper, we will address the question: Can people learn to become good or better decision-makers? If so, how?

Decision-making is central to managing organizations. Some argue convincingly that management *is* decision-making. We talk of decision-making and presume that term is universally understood. People rising to top leadership and management positions are, *de facto*, good decision-makers. Often, the outcome of an uncertain event, where the decision-making has no control, is the major determinant of decision quality, rather than the analysis and thought processes of the decision-maker. Some consider good decision-making an innate characteristic; others say good decision-making can be learned and developed; some argue decision-making is an individual, intuitive and creative sort of thing; others believe decisions can be scientifically analyzed and an optimal decision made by analysis. Before we begin to address these issues we must define and clarify good decision-making, the topic of this paper.

Decision-making, especially in organizations, has been studied for centuries but modern decision theory was not conceived until the original work of von Neumann and Morgenstern (1947). Their work laid the foundation for modern decision analysis and for much of micro-economic theory and many behavioral theories of choice. At about this time, Herbert Simon began his life's work of studying decision-making in organizations, ultimately leading to his 1978 Nobel Prize in economics (for defining rationality in human decision-making).

Herbert Simon: Biographical Sketch

Herbert Simon, born in 1916 in Milwaukee, received an undergraduate education at the University of Chicago, and was awarded a bachelor's degree in political science. He concentrated on political science, economics, advanced mathematics, symbolic logic and statistics.

Simon fashioned himself as a quantitative social scientist. He worked with research groups at the University of Chicago and the University of California at Berkeley before completing his Ph.D. degree. He taught at the Illinois Institute of Technology in 1942 and, in 1947, published the first edition of *Administrative Behavior*, based upon his Ph.D. dissertation. This was the basis for his Nobel Prize winning research into decision-making. In 1949, Simon took a position at Carnegie Institute of Technology, which later merged with Mellon University to become Carnegie-Mellon University, to develop a new Graduate School of Industrial Administration curriculum; it was intended to provide business education for students with technical degrees, with emphasis on the application of science to managing organizations. He remains at Carnegie-Mellon today as professor of computer science and psychology. His research extends primarily into two fields: cognitive psychology of human decision-making and computer science. Simon virtually invented the field of artificial intelligence when he began early work of applying computer science to mimic and assist human decision-making. He has written more than

700 books, monographs and articles and made substantive contributions to political science, sociology, psychology, computer science, public administration, management and philosophy.

His conception of rationality in human decision-making was fundamentally different from the classical notions embodied in economic and game theories. Simon's *administrative man* was more limited in decision-making capacities than was the classical *economic man*. At the risk of over simplification, Simon believed man has limited or bounded rationality, as compared to the global rationality presupposed in classical economic and game theories. Moreover, man did not seek to optimize in his decision-making processes but, instead, sought to select alternatives that were simply good enough. Simon was one of the first researchers to consider normative and descriptive decision theories: a normative theory describes how decisions *should be made*, whereas a descriptive theory describes how decisions are *actually made*. Simon's Nobel Prize winning work reduced the gap between normative and descriptive theories of the time.

We hope to provide you a description of Simon's conceptions of rationality and how they apply to the important decision process known as source selection. We summarized mostly from the latest edition (1976) of Simon's *Administrative Behavior*.

Fact and Value in Decision

Simon believes there are two important elements in a decision problem, factual and value. This classification is crucial to understand good decision-making. He points out:

> This distinction proves to be a very fundamental one for administration. It leads first of all to an understanding of what is meant by a "correct" administrative decision. Secondly, it clarifies the distinction, so often made in the literature of administration, between policy questions and questions of administration. (Simon, 1976, p. 45.)

Factual propositions are statements about the observable world. They are judged by empirical evidence to be true or false. As examples; the advanced technology fighter (ATF) attains a top speed of Mach 2.5 or it does not; the advanced technology fighter has an operational ceiling of 60,000 feet or it does not.

In addition to factual elements, all decision problems involve an ethical dimension, which encompasses the value elements of a decision. Rather than paraphrase, we quote directly from Simon (1976):

> Decisions are something more than factual propositions. To be sure, they are descriptive of a future state of affairs, and this description can be true or false in a strictly empirical sense; but they possess, in addition, an imperative quality—they select one future state of affairs in preference to another and direct behavior toward the chosen alternative. In short, they have an ethical as well as factual content....
>
> It is a fundamental premise of this study that ethical terms are not completely reducible to factual terms....
>
> From this viewpoint, if a sentence declares that some particular state of affairs "ought to be," or that it is "preferable" or "desirable," then the sentence performs an imperative function, and is neither true or false, correct nor incorrect. Since decisions involve valuation of this kind, they too cannot be objectively described as correct or incorrect.

Continuing the above example, it is an ethical, or value, premise that the advanced technology fighter *ought* to have a top speed of Mach 2.5. One cannot argue about whether it is correct to require the ATF to have this operating characteristic. It is a subjective evaluation, an opinion.

Value elements, then, may be considered aspects of a decision that are *subjective*. They are opinions that can never be judged true or false, correct or incorrect. As we shall see, value elements form the basis upon which the goodness of a decision is evaluated.

Consequences of this distinction between factual and value elements of a decison are far-reaching for our concept of "good" decisions. Each and every decision contains subjective aspects and we cannot say, *in any absolute sense*, that it is correct or incorrect. *Every* decision *must* include value elements. Therefore, every decision *must* include subjective judgments and opinions. We cannot judge, *in any purely objective way*, whether a particular decision is "good" or not.

Have we reached a dead end, then, in our quest for a conception of a "good" decision? Are we inextricably stuck in this quagmire of subjectivity? Is this as far as we can go in characterizing "good" decision-making? Not hardly. According to Simon:

> We see that, in a strict sense, the administrator's decisions cannot be evaluated by scientific means. Is there no scientific content, then, to administrative problems? Are they purely questions of ethics? Quite the contrary: to assert that there is an ethical element involved in every decision is not to assert that decisions involve only ethical elements....
>
> Hence, there is one sense in which the correctness of his decisions can be judged: it is a purely factual question of whether the measures he takes in order to accomplish his aim are appropriate measures. It is not a factual question whether the aim itself is correct or not, except in so far as this aim is connected, by an "in order," to further his aims....
>
> Decisions can always be evaluated in this relative sense—it can be determined whether they are correct, give the objective at which they are aimed—but a change in objective implies a change in evaluation. Strictly speaking, it is not the decision itself which is evaluated, but the purely factual relationship that is asserted between the decision and its aims....

The last point may be stated in a more positive way. In order for an ethical proposition to be useful for rational decision-making, (a) the values taken as organizational objectives must be definite, so that their degree of realization in any situation can be assessed, and (b) it must be possible to form judgments as to the probability that particular actions will implement these objectives. (Simon, 1976.)

What Simon means by factual premises is important and has direct implication for judgment in decision. He states:

The division of the premises of decision into those that are ethical and those that are factual might appear to leave no room for judgment in decision-making. This difficulty is avoided by the very broad meaning that has been given to the word "factual": a statement about the observable world is factual if, in principle, its truth or falsity may be tested. That is, if certain events occur, we say the statement was true; if other events occur, we say that it was false....

This does not by any means imply that we are able to determine in advance whether it is true for false. It is here that judgment enters. In making administrative decisions it is continually necessary to choose factual premises whose truth or falsehood is not definitely known and cannot be determined with the information and time available for reaching the decision. (Simon, 1976.)

Now we are beginning to make progress. To judge if one course of action is better than another, we must:

—Have clearly defined value judgments, also know as organizational objectives

—Be able to assess probability that a particular course of action will lead to particular consequences

—Assess relative merits of alternative courses of action based upon these probabilities and the desirablity of consequences with respect to stated values.

Current source selection procedures and practices take explicit account of this important distinction between factual and value premises of decision.

Implications for Source Selection

Current source selection procedures and practices take explicit account of this important distinction between factual and value premises of decision. The source selection authority, with advice of the source selection advisory council, ultimately determines value elements that will guide the source selection decision. Value elements take the form of the specific criteria on which this important decision will be based; they go further by specifying the relative importance, or weight, of criteria. Value elements of the source selection decision are carefully and clearly stated in the source selection plan, and are described in enough detail to meet the usefulness criteria, mentioned previously:

—The values taken as organizational objectives must be definite, so their degree of realization in any situation can be assessed

—It must be possible to form judgments regarding the probability that particular actions will implement these objectives.

It is the task of evaluation teams to judge, precisely in the sense described above by Simon, the factual elements of the source selection decision. These teams of functional experts are equipped to determine what should be evaluated (factual elements) to assess how well proposals met specified objectives (value elements). These experts are most qualified to assess the *likely* truth or falsity of factual elements that fall in their domain. For example, cost analysts evaluate *factual content* of the alternative courses of action (i.e., contractor proposals) regarding predicted costs, and the *probability* of attaining these costs. Engineers perform the same types of judgments regarding design and performance characteristics.

Rationality in Decision-making

Having made the important distinction between factual and value elements of a decision, it is possible to proceed toward a concept of rationality in decision-making. Simon said:

...it was concluded that the correctness of an administrative decision is a relative matter—it is correct if it selects appropriate means to reach designated ends. The rational administrator is concerned with the selection of these effective means...it is necessary to examine further the notion of rationality and, in particular, to achieve perfect clarity as to what is meant by "selection of effective means"....

...concentration on the rational aspects of human behavior should not be construed as an assertion that human beings are always or generally rational. That misconception, which permeated utilitarian political theory and a large part of classical economic theory, has been decisively refuted by modern developments in psychology and sociology. (This important topic, whether humans are innately rational in decision-making processes, is crucial and is the topic of another paper. Simon recognized there is discrepancy between

what decision-makers actually do and what good decision-makers ought to do, according to an adopted theory of rationality.)

Means-Ends Hierarchy

In a complex decision problem it is not possible to specify simply the ends and alternative means for achieving those ends. Whereas there is direct correlation between the value elements and the desired ends in a decision, and factual elements and the means for achieving desired ends, specifying the relationship between means and ends, specifying the linkages between courses of action and desired outcomes is complicated, in part, because:

> Ends themselves, however, are often merely instrumental to more final objectives. We are thus led to the conception of a series, or hierarchy, of ends. Rationality has to do with constructing means-ends chains of this kind. (Simon.)

Thus, as a first step toward rational decision-making, it is necessary to analyze, or decompose, a complex problem into means-end chains that naturally form a heirarchical structure. Only when such linkages and relationships are understood is it possible to proceed toward rationality. As Simon said:

> The fact that goals may be dependent for their force on other more distant ends leads to the arrangement of these goals in a hierarchy—each level to be considered as an end relative to the levels below it and as a means relative to the levels above it. Through the hierarchical structure of ends, behavior attains integration and consistency, for each member of a set of behavior alternatives is then weighted in terms of a comprehensive scale of values—the "ultimate" ends. In actual behavior, a high degree of conscious integration is seldom attained. Instead of a single branching hierarchy, the structure of conscious motives is usually a tangled web or, more precisely, a disconnected collection of elements only weakly and imcompletely tied together; and the integration of these elements become progressively weaker as the higher levels of the hierarchy—the more final ends—are reached.

Function of Knowledge In Decision

Knowledge of the specific decision domain directly influences the decision-maker's ability to construct the means-ends chains or, alternatively stated, to ascertain consequences of particular alternatives. Usually, it is not possible to do this with certainty of relationships and linkages between means and ends, or alternatives and consequences. Often, the major cause of this difficulty is uncertainty about the future. This, in turn, necessitates estimation of the degree of uncertainty involved, which takes the form of expectation, risk, or probability. While these terms have precise and different meanings in probability theory and decision theory, they are popularly used to imply the same notion: uncertainty about future consequences. Subsequent papers will clarify distinctions between terms as used in probability and decision theory.

> The function of knowledge in the decision-making process is to determine which consequences follow upon which of the alternative strategies. It is the task of knowledge to select from the whole class of possible consequences a more limited subclass, or even (ideally) a single set of consequences correlated with each strategy. The behaving subject cannot, of course, know directly the consequences that follow upon his behavior. If he could, a sort of reverse causality would be operating here—future consequences would be determinants of present behavior. What he does is to form expectations of future consequences, these expectations being based upon known empirical relationships, and upon information about the existing situation. (Simon.)

The final stage of decision is establishing preferences among the consequences, termed *evaluation* by Simon.

> To each (course of action) corresponds a unique set of consequences. Rational behavior involves a listing of consequences in their order of preference, and the choice of that strategy which corresponds to the alternative highest on the list. (Simon.)

Definitions of Rationality

We are in a position to present Simon's definitions of rationality. He found it necessary to distinguish between types of rationality in decision-making, depending upon whether the decision was (1) conscious or unconscious, (2) correct or incorrect with respect to the information and knowledge available to the decision maker, or (3) in congruence with individual or organizational values. We quote Simon:

> A principal aim...has been to build the foundations upon which a clear understanding of the concept of "rationality" could be erected. Clarity does not necessarily imply simplicity, however. Roughly speaking, rationality is concerned with the selection of preferred behavior alternatives in terms of some system of values whereby the soncequences of behavior can be evaluated. Does this mean the process of adaptation must be conscious, or are unconscious processes included as well? It has been shown that many of the steps in mathematical invention—than which there can presumably be nothing more rational—are subconscious....Moreover, if consciousness is not stipulated as an element of rationality, are only deliberate processes of adaptation admitted, or non-deliberate ones as well?
>
> Shall we, moreover, call a behavior "rational" when it is in error but only because the information on which it is based is faulty?
>
> Finally, in terms of what objectives, whose values, shall ra-

tionality be judged? Is behavior of an individual in an organization rational when it serves his personal objectives, or when it serves the organizational objectives?

Perhaps the only way to avoid, or clarify, these complexities is to use the term "rational" in conjunction with appropriate adverbs. Then a decision may be called "objectively" rational if in fact it is correct behavior for maximizing given values in a given situation. It is "subjectively" rational if it maximizes attainment relative to the actual knowledge of the subject. It is "consciously" rational to the degree that the adjustment of means to ends is a conscious process. It is "deliberately" rational to the degree that adjustment of means to ends has been deliberately brought about (by the individual or by the organization). A decision is "organizationally" rational if it is oriented to the organization's goals; it is "personally" rational if it is oriented to the individual's goals.

Implications for Source Selection

It seems clear that the current source selection process, as embodied in FARs, directives and policies, is intended to provide the decision-maker with a framework for rational decision-making. Moreover, the source selection process appears to be constructed to promote objective rationality, subjective rationality, deliberate rationality and organizational rationality. Each is discussed below.

Objective Rationality in Source Selection

The source selection plan prescribes clearly and unambiguously the *system of values* to guide the decision process. These are provided in precisely the hierarchical structure described above. Specifically, the source selection authority's value system is communicated in the source selection plan in terms of areas, which are further subdivided into items, which are further broken into factors, and then subfactors, depending upon complexity of the decision and the detail required to clearly establish the means-ends chains necessary to discriminate between decision alternatives. Without such a clear statement of the value system to be employed in the source selection decision, objective rationality would be impossible.

Also necessary for objective rationality is selection of "the correct behavior for maximizing the given values." Correct behavior, in the context of source selection, is selection of the contractor whose proposal is deemed most likely to lead to desired consequences. It is here that evaluation teams provide expert judgment to the source selection authority. Functional experts should possess a high degree of knowledge in their areas of expertise. They are, therefore, best qualified to determine "which consequences follow upon which of the alternative strategies." and "to form expectations of future consequences...being based upon known empirical relationships, and upon information about the existing situation."

Roughly speaking, evaluation teams construct means-ends chains by scoring the particular areas, items, factors and subfactors and by assessing levels of risk. The colors, numbers or symbols used as scores, are, in reality, estimates of the future consequences associated with particular alternatives. Each assessment of high, medium, or low risk level for each score is, in reality, the expectation or probability of that specific future consequence occurring.

The current source selection process fosters application of judgment by those possessing the greatest degree of specific knowledge to determine which aternatives are expected to result in the preferred consequences, within the precisely stated system of values. Adequate provision is made for attaining objective rationality in the source selection decision process.

It is important to point out, as a final note regarding objective rationality, that it is essentially impossible to attain objective rationality. To do so, the decision-maker must know all alternatives, construct all appropriate means-ends chains, assess expectations for all uncertain consequences, etc. It is here that Simon's notion of bounded rationality takes form. The decision-maker can know these important aspects of decision only within the limits imposed by experience, knowledge, time and effort available to search and study the decision environment.

Subjective Rationality in Source Selection

Subjective rationality is attained if the decision "maximizes attainment relative to the actual knowledge of the subject." Simon did not distinguish relative degree of subjective rationality. According to his definition, a decision is subjectively rational or it is not. Thus, a decision-maker untrained in systems acquisition and unfamiliar with the source

selection process can, in Simon's concept of rationality, make "just as" subjectively rational a decision as a systems acquisition expert. How then, does this concept apply?

A source selection decision only can be deemed subjectively irrational if the decision-maker does not select the best alternative with respect to available knowledge. There appear to be two instances that could cause this to occur: (1) the decision-maker selects an alternative other than the best one dictated by current state of knowledge; or, (2) the decision-maker does not employ all knowledge available at decision time.

If we agree with Simon's ideas, the source selection authority's decision to select a contractor other than the best one, as dictated by subjective rationality, could occur only under the following circumstance: the decision-maker's concept of best differs from that dictated by the system of values embodied in the source selection plan and the knowledgeable judgments made by the evaluation teams. Now, the concept of best can differ only because one:

—Does not agree with system of values
—Does not agree with one or more judgments of evaluation teams
—Employs a different means of synthesizing the multitude of judgments into a final decision.

The first instance requires the system of values to be revised. The second implies ineffective use of available information, in the form of expert judgments. The third requires examination of how the many scores and risk levels are rationally combined into a single, overall decision—an important topic to be discussed in another paper.

Conscious, Deliberate and Organizational Rationality In Source Selection

These forms of rationality require little discussion. The source selection process is conscious and deliberate. One hardly can argue that source selection decisions are made subconsciously out of force of habit or by conditioned response. Conscious thought must inevitably be brought to bear on this complex and important decision.

Equally as certain is the fact that organizational rationality should supplant individual rationality in the source selection process. That is not to say that source selection decisions cannot and are not made, at least in part, on the basis of individual goals. Ideally, individual goals and organizational goals are congruent. Thus, source selection decisions can be individually and organizationally rational. On occasions where individual goals and organizational goals are in conflict, decisions should be made on the basis of organizational goals as specified in the source selection plan. A potentially serious problem of conflict of interest occurs if source selection decisions are knowingly made on the basis of personal values which are at odds with organizational values.

Conclusion

The purpose of this paper is to address: What is good decision-making? The answer is important to decision-making in general and to the particular decision process of source selection. Without a clear concept of what constitutes good decision-making, it is impossible to assess whether one decision process, or the choice of one alternative is superior to another.

We have, in this paper, taken good to mean rational. The Webster dictionary definition of rational seems simple enough: having reason or understanding 2a: of relating to, or based upon reason...4a: agreeable to reason: intelligent, sensible.

We see quickly that, in the context of important and complex decision-making, this idea is complicated. While there have been noted scholars and experts studying the decision process from different perspectives in the last half century, we elected in this paper to adopt Herbert Simon's conception of rationality. A critical assessment of the current framework for source selection as embodied in existing Federal Acquisition Regulations, and other Department of Defense, service and command regulations, policies and directives, draws us to the conclusion that it provides an environment conducive to rational decision-making. Whether or not rational decision-making actually takes place depends upon the specific behaviors of the decision-maker(s) within this environment.

Having proffered a concept of good decision-making, we will turn our attention to the important issue of whether or not people inherently make good decisions. Do people inherently behave in accordance with Simon's concept of rationality when confronted with complex decision problems? This is the topic of another paper.

Bibliography

Air Force Regulation 70-15, "Formal Source Selection for Major Acquisitions," April, 1988.

Francis, V., R. Grey, J. Stonebraker, R. Tremaine, et al, "Decision Analysis in Source Selection for Defense Systems Acquisition," paper presented at Joint National Meeting of Institute of Management Sciences and Operations Research Society of America, Las Vegas, Nevada, May 7, 1990.

March, James G., "Bounded Rationality, Ambiguity, and the Engineering of Choice," *Bell Journal of Economics*, Vol. 9, 1978, pp. 587-608.

Simon, Herbert A., "A Behavioral Model of Rational Choice," *Quarterly Journal of Economics*, Vol. 69, 1955, pp. 99-118.

Simon, "Rational Choice and the Structure of the Environment," *Psychological Review*, Vol. 63, 1956, pp. 129-138.

Simon, Administrative Behavior: *A Study of Decision-Making Processes in Administrative Organization*, Third Edition, New York, NY: The Free Press, 1976.

Simon, *The New Science of Management Decision*, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1977.

Unknown, "Herbert Simon: A Retrospective," paper presented at the Eastern Academy of Management National Meeting, Washington D.C., May 14-17, 1987.

von Neumann, J. and O. Morgenstern, *Theory of Games and Economic Behavior*, Princeton, N.J., Princeton University Press, 1947.

Webster's Third New International Dictionary, Springfield, Mass., G & C Merriam Company, 1971.

CONCURRENT ENGINEERING: A NEW INITIATIVE

(Continued from page 25)

required to accomplish concurrent engineering.

Summary

I have looked at a new initiative taken by the Department of Defense and industry to rectify the poor performance of systems engineering. It is imperative that something be done; things are in a mess. Concurrent engineering is the new initiative.

Whether or not concurrent engineering succeeds will depend largely on the success of two ongoing efforts.

The first is the implementation of recommendations from the recent Concurrent Engineering Workshop for improving understanding of concurrent engineering within DOD and industry. This is needed to overcome the primary barrier—lack of understanding of concurrent engineering.

The second is the acceptance and implementaion of MIL-STD-499B, released as a pre-coordination draft in May. This standard is intended to implement concurrent engineering within the Department of Defense and industry for weapon system acquisitions.

If these efforts are successful, the goals of systems engineering will be met; manufacturing, support and other disciplinary concerns will be satisfied; weapon system acquisitions will be more efficient; products will improve in quality, and the United States can become a world-class industrial nation.

Yes, concurrent engineering and systems engineering are essentially the same. Yes, concurrent engineering is not new. But, its time for a change.

Much is riding on this initiative. Discipline agendas must be put aside. New paradigms must be developed. A cooperative effort must be made to make concurrent engineering work. Each individual reading this article must be part of the solution.

Our mess is no laughing matter.

Bibliography

Alberts, Henry C., Paper on "Operations Researching the Systems Engineering Process," May 1990.

Chase, Wilton, P., "Management of Systems Engineering," Wiley: New York, N.Y., 1974.

Evanczuk, Stephen, "Concurrent Engineering-The New Look of Design," *High Performance Systems*, April 1990, p. 16.

Linton, Larry R., "Untangling the Knot of Product and Process Design," *High Performance Systems*, April 1990, p. 14.

MIL-STD-499B Pre-Coordination Draft, "Systems Engineering," May 15, 1991, ASD/ENS & DSMC/SE-T.

"Report on the DOD Workshop on Concurrent Engineering," Defense Systems Management College, November 14-15, 1990; December 17-21, 1990; and January 28-29, 1991.